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SOME ASPECTS OF THE MINERAL REQUIREMENTS OF SMALL ANIMALS

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PART I

DIETS AND DISEASE: SOME INTRODUCTORY CONSIDERATIONS

It is clear from the outset that a knowledge of the metabolism of small animals is of the utmost importance to all veterinary workers, for although the larger farm animals stake prior claims in our interests, yet it is often by reason of extensive experiments on the smaller higher vertebrates that much of our knowledge of the larger species is based.

With regard to mineral requirements and disorders—these two aspects must be considered together—of animals large and small, the literature is very extensive, although in the case of the smaller species the majority of papers deal with induced conditions brought about by deliberate quantitative alterations of the animal's dietary components. On the other hand, the catalogue of "naturally" occurring metabolic disorders resulting from mineral abnormalities—excluding direct "poisoning" (see later)—is small.

Our knowledge of this aspect, certainly as far as small animals are concerned, is more or less limited to dental hypoplasia, rickets, endemic goitre and nutritional anaemia. This state of affairs undoubtedly is due to three main causes. Firstly, the fact that under normal living conditions—domestic and wild—the small animal has access to adequate if not liberal quantities of the necessary minerals. Secondly, that with the exception of those dysfunctions which include early and relatively easily recognisable clinical manifestations (*e.g.*, rickets) subnormal levels of a particular mineral or minerals evince more general and widespread upsets of the metabolic functions not specifically attributable to a mineral disturbance (*e.g.*, chloride deficiency). Thirdly, the interest in small animals as a whole continues to be more academic than economic in spite of the obvious fundamental importance to pure and applied experiments.

The purpose of this article is to attempt a brief presentation of the main facts relative to the mineral requirements and disorders of the smaller domestic mammals and to indicate, by the utilisation of experimental evidence, what symptoms are likely to be encountered as the result of severe deviations from normal intakes and metabolism.

No attempt has been made to quote exhaustively from the literature, and certain selected references are given which will enable the reader to gain further and more detailed information on any particular point. As regards mineral metabolism generally, there are several textbooks; for example, Shohl,[1] Maynard,[2] Linton and Williamson,[3] which give a mass of general information, and the more recent advances are well presented in the Annual Review of Biochemistry, [4 5 6 7]. There are several accounts on the nutritional requirements of the dog, among which those of Michaud and Elvehjem[8] and of McCay[9] are representative. The requirements of fur animals have been published by Kellogg[10], the rabbit by Wilson and McCartney,[11] the rabbit and guinea-pig by Hogan and Ritchie,[12] the rat by various authors summarised by Griffith and Farris[13] and the mouse by Morris.[14] There has been very little written on the specific nutritional requirements of the cat, and this animal does not appear to have been afforded such a place of prominence in this particular branch of technical literature as have those animals previously mentioned. Trace element metabolism in animals is the subject of a review by Underwood[15] and a full account of their roles in plants, as well as in animal systems, has been given in a recent book by Stiles.[16]

In addition, a considerable amount of general information on this aspect is contained in "Trace Elements in Relation to Health," a symposium held in London in 1942.[17]

Disorders due to mineral disturbances are to be found in most of the works of reference already quoted, and good reviews of the histopathological aspects have been presented by Follis.[18 19] The Iodine Educational Bureau have published two excellent accounts of iodine metabolism in Animal Goitre in England and Scotland[20] and World Goitre Survey.[21]

One cannot conclude the list without referring to E. Mellanby's "Nutrition and Disease,"[22] summarising all the salient features of the fundamental work carried out both by himself and by May Mellanby.

Criticism may be raised on the selection (see above) of the somewhat restricted group of vertebrates, but it is felt that the universal interest of the dog, cat and rabbit, coupled with the wide use of the guinea-pig, rat and mouse in all branches of animal research, will provide adequate terms of reference for studying such of those less well known small mammals which may be encountered by veterinary workers. Furthermore, an additional reason for selecting these animals is that they fall into three more or less well-defined dietary groups, *viz.*, *carnivore*, dog and cat; *herbivore*, rabbit and guinea-pig; *omnivore*, rat and mouse.

Although generalisations are dangerous, it will be as well to examine existing evidence to determine whether it is possible to formulate certain "common denominator" principles to assist in establishing the mineral requirements of small animals and in forecasting disorders likely to arise from mineral dietary disturbances. Bearing in mind that the mammalia under consideration share similar fundamental gross anatomical structures which exhibit marked similarities in chemical composition over different species, and have similar *basic* physiological functions, it is reasonable to assume that the *ultimate* dietary requirements will be similar for the different species as also will be the metabolic dysfunctions arising as a result of any gross alterations in those dietary constituents.

We can obtain a fairly clear picture of the mineral requirements of any animal by examining the analyses of its inorganic "ash," its milk, and even its urine, and these fundamental facts have been utilised many times by experimentalists in compounding successful mineral supplements for the diet of an animal. Examination of the ash content of whole animals and of their individual tissues reveals three main facts. Firstly, that there is marked

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qualitative agreement in the presence of the principal elements. Secondly, taking into account the age, sex, fitness, etc., of the animal there are certain significant quantitative agreements, as for example the calcium: phosphorus ratios. Thirdly, the great bulk of the inorganic elements are present in the skeletal structures of the animals—over 80 per cent. of the total ash being accounted for by the skeleton. Table I illustrates these points.

(*c*) The query indicates that although probably present the analytical figures for this particular element are unreliable or not available.

(*d*) Some considerable variations in the estimates of the iron contents of milks.

(*e*) Over 30 elements including many "traces" have now been identified in cow's milk.

(*f*) Rabbit's milk is very concentrated, *e.g.* [Ca] rabbit's milk is five times as great as [Ca] in cow. This is correlated with the rapid growth rate.

TABLE I

MINERAL CONTENT OF WHOLE, YOUNG, SMALL ANIMALS COMPARED WITH MAN TOGETHER WITH COMPARATIVE MINERAL ANALYSIS OF DRY FLESH (IN GMS. PER 100 GM.)
(P = Principal element; T = Trace element)

Mineral		Animal					Animal flesh		
		Dog	Cat	Rabbit	Guinea-pig	Man	Dog	Cat	Rabbit
Potassium ...	P	0·22	0·23	0·25	0·24	0·35	1·41	1·55	1·71
Sodium ...	P	0·19	0·17	0·12	0·17	0·15	0·40	0·29	0·19
Calcium ...	P	0·80	0·67	0·68	0·80	2·2 (*a*)	0·03	0·03	0·08
Magnesium...	P (*b*)	0·03	0·025	0·036	0·073	0·05	0·10	0·11	0·12
Phosphorus...	P	0·54	0·48	0·49	0·64	1·2	0·95	0·81	1·09
Sulphur ...	P					0·25	0·96	0·87	0·85
Chlorine ...	P	0·23	0·19	0·13	0·33	0·15	0·34	1·22	0·22
Iron ...	P	0·005	0·0023	0·0022	0·0029	0·0004	0·019	0·037	0·023
Iodine ...	T (*c*)					0·00004			
Copper ...	T					0·00015			
Manganese ...	T					0·0003			
Cobalt ...	T					+			
Zinc ...	T					+			
Aluminium...	T					+			
Many other traces						+			
Ca : P ratio...		1·47 : 1	1·39 : 1	1·36 : 1	1·27 : 1	1·8 : 1	1 : 32	1 : 29	1 : 13

Notes.—(*a*) Very variable estimates.
(*b*) Note the greater utilisation of magnesium (from the chlorophyll of plants) by the herbivores.
(*c*) The trace elements present in body of man are also present in the other animals in comparable percentages.

An even clearer insight into an animal's mineral requirements can be provided by a knowledge of the composition of its milk, and although there is some wide variation both in total concentration of solids, and in relative amounts of certain organic constituents, there is complete agreement in the qualitative presence of certain inorganic constituents, and to a certain extent in the ratios, particularly that of calcium and phosphorus. Table II gives analysis figures for the mineral contents of various milks with a comparison of that of the cow.

TABLE II

MILK ANALYSIS FIGURES—COMPARATIVE

Element	Bitch	Guinea-pig	Rat	Rabbit	Cat	Cow
Sodium ...	0·059	0·057	0·076	0·147		0·055
Potassium ...	0·116	0·063	0·170	0·209		0·166
Calcium ...	0·32	0·191	0·349	0·65		0·114(a)
Magnesium ...	0·012	0·015	0·031	0·033		0·012
Chlorine ...	0·160	0·098	0·117	0·135		0·10
Phosphorus (b)	0·22	0·124	0·27	0·435		0·08
Sulphur (c) ...	?	?				0·008
Iron (d) ...	?	?	0·0007	0·0004		0·0007
Copper ...	?	?	0·0007	?		0·0006
Other elements (e)	?	?	?	?		
Total ash ...	0·80	0·77	1·60	2·50 (f)	0·65	0·75
Ca : P ratio ...	1·45 : 1	1·54 : 1	1·3 : 1	1·51 : 1		1·35 : 1

Notes.—(*a*) About 50 per cent. of the calcium in cow's milk is attached to casein.
(*b*) About 65 to 80 per cent. of the total phosphate in cow's milk is in inorganic form.

Disorders due to mineral deficiencies are rarely uncomplicated and although there may be one outstanding symptom there will be those that are less obvious but equally damaging to the animal's health. This complication will become clearer when the following factors are considered. Firstly, there is a close interdependence of mineral metabolism and endocrine activity, and most mineral elements appear to be associated more or less with a specific endocrine. For example, endemic or benign goitre manifested by a swollen thyroid may result from a perfectly straightforward iodine deficiency, but the consequent drop in thyroxine production may well have far reaching effects on the whole of the animal's health. Secondly, the minerals themselves are closely inter-related, biochemically and often chemically, and everyone is acquainted with the well known biological "partners," *e.g.*, calcium and phosphorus, copper and iron, etc. This particular aspect is undoubtedly very significant and with increasing knowledge the "pairs" will be expanded, no doubt, to "trios" and so on. Iodine, often considered in the past as playing a lone hand, is probably not nearly so isolated in its activity and relationships as previously was thought, and there appears to be good evidence that calcium and even fluorine may be bound up in its biological roles. To separate up the elements and even to pair them is unsound scientifically and the examples are given merely to illustrate the close interplay of activities and their mutual need one for the other. Thirdly, the utilisation of minerals is closely associated with other substances in the animal's diet, *e.g.*, vitamin D, calcium and phosphorus. It is now well known that a severe alteration in the percentage of

any of the three variables—Ca, P, and vitamin D—in an animal's diet will lead to rickets, dental hypoplasia or rarely osteomalacia, but unless the exact nature of the diet is known, then a faculty diagnosis will result.

To make an arbitrary standard of a mineral deficiency disorder is not sound, for, although there may be some obvious manifestation—*e.g.*, a swollen thyroid in goitre—there will be degrees of severity which will depend, amongst other things, on the order of deficiency of this particular element or elements.

Thus a mild and/or temporary deficiency often may cause a general loss of condition, sterility, etc., not specifically attributable to a shortage of minerals. In the larger farm animals this is often suspected and even proved, and a mineral supplement probably will have excellent results in boosting milk production, standard of meat, etc. In the smaller animals, however, these deficiencies are not easily noted, neither is there the economic need for increased rate of productivity, etc.

When assessing the degree of severity of a nutritional deficiency disease it is necessary to consider the part—undoubtedly no small one—played by loss of appetite. This may be due to several causes, amongst which must be numbered reduction in palatability of the diet (this has often been noted in experiments dealing with synthetic diets, etc.) and the effect of the resulting upset to the animal's general health—either simply or more indirectly through the inception of a complication (see remarks on dental hypoplasia in later section).

In other words, unless the pathological symptoms are arrested by therapeutic treatment or by appropriate modifications of the diet, deficiency and disease will have a mutually stimulating effect.

It may be felt that this aspect is rather laboured, but it is suggested that it has been neglected far too often in the past, and that if proper attention is paid to it in the future, the detrimental "irreversible" changes which can result from a severe and prolonged deficiency will be prevented.

The great scarcity of information, particularly of a clinical nature, on the mineral nutritional diseases of all animals—especially the smaller species—is to be deplored and this makes it imperative that fuller cognisance be taken of the detailed mineral composition of common diets in relation to animal health—as it is very possible that a closer scrutiny will reveal some deficiency—mild or severe—which will probably have a direct bearing on the particular clinical problem.

PART II

GENERAL MINERAL REQUIREMENTS

Elements utilised by animals can be divided into two main groups as under:—

Principal. Carbon, hydrogen, nitrogen, oxygen sulphur calcium, magnesium, phosphorus, sodium, potassium, chlorine, iron.

Trace. A very large number of the other elements of the periodic classification, amongst which the following definitely have been identified in biological material: Copper, manganese, iodine, zinc, cobalt, nickel, fluorine, bromine, aluminium, strontium, boron, silicon, vanadium, molybdenum, selenium, etc.

The first four principal elements form the bulk of living organic material, the remainder are widely distributed in: bone (calcium and phosphorus), in blood (iron), in body fluids as electrolytes (sodium, potassium, chlorine) and in other tissues. The trace elements are almost universally present in very small quantities relative to the principals and may be beneficial (copper, zinc, manganese, iodine), harmful (fluorine, selenium, molybdenum), or even apparently harmless (strontium) when they are present as mere fortuitous "impurities." Plant and animal tissues have very varying compositions, but, provided that the soil contains all the necessary elements—principal and trace—the plant will absorb them and pass them on to the animal (Harvey,[23]). Our knowledge of trace elements is very limited, but with improving analytical technique the gaps will be filled and perhaps further essential traces will be

TABLE III

AVERAGE AMOUNTS OF PRINCIPAL ELEMENT IN SOME COMMON FOODSTUFFS IN GMS. PER 100 GM. (*a*)

Foodstuff	Calcium	Phosphorus	Magnesium	Sodium (*b*)	Potassium (*c*)	Chlorine	Sulphur	Iron	Calcium : Phosphorus ratio (*d*)
Bran	0·11	1·06	0·53	0·18	1·25	0·09	0·20	0·0105	0·10 : 1
Oatmeals ...	0·06	0·38	0·14	0·03	0·36	0·07	0·14	0·0048	0·16 : 1
Beans	0·14	0·52	0·14	0·065	1·07	0·10	0·06	0·0105	0·27 : 1
Soya bean flour...	0·216	0·58	0·22	?	1·50	0·24	0·30	0·0027	0·38 : 1
Dried blood ...	0·10	0·13	0·024	0·89	0·24	0·93	?	0·3000	0·80 : 1
Bone meal ...	27·0	22·0	?	?	?	?	?	?	1·22 : 1
Meat meal ...	0·28	0·30	?	?	0·08	?	?	?	0·90 : 1
Lean meat ...	0·007	0·22	0·024	0·08	0·32	0·07	?	0·0030	0·03 : 1
Fish meal ...	7·10	3·80	?	0·06	0·42	1·00	?	?	1·90 : 1
Milk, cow ...	0·11—	0·08—	0·012	0·06	0·16	0·10	0·08	0·0002	1·37 : 1
(*e*)	0·21	0·09							
Potato	0·01	0·06	0·03	0·014	0·50	0·03	0·036	0·0011	0·16 : 1
Cabbage ...	0·14	0·06	0·018	0·007	0·29	0·02	0·08	0·0005	2·10 : 1
Turnip	0·05	0·25	0·06	0·022	0·63	0·17	0·06	0·0005	0·20 : 1
Clover hay ...	1·40	0·21	0·27	0·089	1·66	0·24	0·18	?	6·90 : 1
Grass pasture ...	0·14	0·06	0·06	0·036	0·52	9·40	?	?	2·30 : 1
Yeast	0·22	2·00	1·20	?	1·27	0·03	?	?	0·11 : 1

Notes.—(*a*) Where there is doubt as to the average composition of a particular substance, and where, usually, it exists only in smallish amounts a (?) has been inserted. (See Table II.)

(*b*) Sodium is relatively scarce in plant tissues (hence salt lick supplements for farm animals).

(*c*) Potassium is present in adequate quantities in most plant cells and in red blood cells of animals.

(*d*) The Ca : P ratio has been included to demonstrate the importance of the values 1·2–0·8 : 1 to the animal body. Note milk, bone ash, etc., and compare with, say, fresh meat and potato.

(*e*) In milk about 0·8 per cent. of phosphorus is "bound" to the casein molecule and about 80 per cent. of the calcium.

fixed in the various plant and animal metabolic scheme. Tables III and IV give the approximate compositions of some common foodstuffs from plant and animal sources.

TABLE IV

AVERAGE AMOUNTS OF FOUR ESSENTIAL TRACE ELEMENTS IN SOME COMMON FOODSTUFFS (IN PARTS PER MILLION)

Foodstuff	Iodine (*a*)	Copper	Manganese	Zinc
Wheat	4– 9	7·8	46	In fruits and vegetables about 2 to 5 mgm. per 100 gm. In oysters 40 mgm. Milk 2 mgm. per 100 gm. or less
Oats ...	23–175	7·4	50	
Potato	10–700	1·6	7·3	
Lettuce	600	0·7	7·7	
Milk ...	570	0·35	0·06	
Fish ...	500–50,000	1–2	0·1–0·15	

Note.—(*a*) These quantities show very great variation even in individual foodstuffs, and they apply, of course, to non-goitrous regions.

Attention is drawn to the Ca:P ratios which have been calculated for each individual food, and comparison should be made with the ratios of the milks of different species as set out in Table I.

The mineral requirements of the dog have been reviewed by Michaud and Elvehjem (*loc. cit.*) and their figures are compared with those of Arnold and Elvehjem.[24] These are given in Table V.

TABLE V

MINERAL REQUIREMENTS OF DOG

Element	Michaud and Elvehjem		Arnold and Elvehjem
	gm./kg. bodyweight	gm./100 gm. ration	gm./kg. bodyweight
Calcium	0·508	0·127	0·02
Phosphorus ...	0·268	0·067	—
Phosphorus (*a*) ...	0·428	0·107	0·04
Sodium chloride ...	0·596	0·149	0·30
Potassium	0·520	0·130	0·08
Magnesium ...	0·0358	0·00895	0·01
Iron	0·00098	0·000245	0·0004
Copper	0·000272	0·000068	0·00006
Manganese ...	0·000312	0·000078	0·00004
Zinc	0·000416	0·000104	0·00006
Iodine	0·00216	0·00054	0·000001

Note.—(*a*) Value when phosphorus content of casein is included.

The only deficiencies likely to occur in a dog's diet are sodium chloride, calcium and phosphorus, and more rarely iodine and iron. The former can be supplemented by adding common salt from 1·0 to 1·7 per cent. as required. The young dog will require adequate quantities of calcium and phosphorus, so also will the pregnant bitch. These elements may be supplied in the form of bones, bone meal, etc.

As regards the cat, our knowledge is very limited, but it is within reason to assume that the dietary requirements are of the same order as those of the dog. When it is considered that the average domestic cat has liberal quantities of milk and fish in its diet it will be appreciated that mineral deficiency diseases, resulting from shortages of the principal elements at any rate, are likely to be very rare.

Rabbits and guinea-pigs, the true vegetarians of the group, often require heavy calcium supplements—especially for the young animals, which grow very rapidly; these can be supplied in the form of good quality grass or hay. Salt should also be supplied in the form of a salt lick. Corrie[25] states that iodine can be added to the extent of 1·4 mgm. per diem with beneficial results.

Rats and mice normally receive very special attention in the laboratory, although elsewhere they are treated as pests. Beard (quoted by Morris, *loc. cit.*) states that "at least 7 per cent. of a well-balanced salt mixture is necessary for the optimum growth of mice." Morris, on the other hand (*loc. cit.*), shows that by feeding varying amounts (3·8 per cent.) of standard salt mixtures to batches of mice there is little variation in the percentage of body ash (2·9 to 4·4 per cent.), and in the phosphorus of the ash (16·5 to 18·3 per cent.). Rats have similar requirements (Griffith and Farris; *loc. cit*) and most standard salt mixtures appear to be adequate.

PART III

DISORDERS DUE TO DEFICIENCIES OF THE ESSENTIAL ELEMENTS EXCLUDING "POISONING"

Disorders arising from deficiencies of sodium, potassium, chlorine, magnesium and sulphur are very unlikely to be met in practice. Those of more probable occurrence will arise from deficiencies in calcium, phosphorus, iron and iodine, and more rarely from cobalt, zinc and manganese. All will give more or less characteristic manifestations except when present in barely sub-normal quantities when the indefinite "lack of condition" symptoms will result. Although deficiency diseases from the first group of elements are rarely "natural," the experimental work in this particular field is summarised in some of the following paragraphs as it is considered it may serve as a guide to clinicians.

Mineral disorders may be divided into two somewhat arbitrary classes: Firstly, those that arise as the result of an abnormality in the normal mineral composition of the animal's diet (*e.g.*, nutritional anaemia). Secondly, those that are the result of a gross excess of any element, usually a metal. More attention will be paid to the first class, but little to the second since this group includes fairly well documented reports of "poisoning" which are either artificially sporadic (arsenic, lead, mercury) or naturally localised (molybdenum and selenium). Quite obviously, this division is open to criticism on purely scientific grounds and is adopted here merely for the sake of presentation.

A. CALCIUM AND PHOSPHORUS

(i) RICKETS AND OSTEOMALACIA

According to Hutyra and Marek[26] rickets occurs in puppies, in wild carnivores, in apes in captivity and in the wild hare. Osteomalacia—the adult form of rickets—is very uncommon in dogs and is stated by these authors to be predominantly a disease of herbivorous animals, although Brumley[27] merely refers to its rarity in small animals without quoting any examples. This author also draws attention to two additional facts, namely, that cats and rabbits are not often affected by rickets and that the disease is commoner in the larger breeds of dogs than in the smaller—"perhaps due to their more rapid growth during life."

The deformity occurring in rickets is found mainly in connection with the long bones of the body. The diaphyses

of the bone are shortened, softened, and become spongy. The epiphyses are thickened, more or less, and much enlarged. The bones are much softer than normal and have the consistency of decalcified bone.

The periosteum is thickened and reddened and when removed from the bone may include some of the bone substance. The short bones are found to be spongy and easily separated.

Deformity also occurs in the skull bones.

Affected animals show general symptoms of malnutrition, gastric and intestinal disturbances, softening and bleeding of the gums, loss of teeth and general bodily deformity.

The chemical composition of rachitic bone differs very markedly from the normal and is well illustrated in the following Table VI taken from Shohl (*loc. cit.*).

TABLE VI

DIFFERENCES IN THE CHEMICAL COMPOSITION OF THE RIB BONES OF RACHITIC AND NON-RACHITIC HUMAN INFANTS

Substance	Amount per cent.	
	Normal	Rachitic
Water	11·56	10·70
Organic matter ...	37·14	42·73
Sodium	0·64	0·73
Potassium	0·30	0·31
Calcium	24·40	21·47
Magnesium ...	0·10	0·63 (*a*)
Phosphate (PO_4) ...	33·56	30·38
Phosphorus	10·93	9·90 (*b*)
Carbonate	3·11	2·70

Notes.—(*a*) Increased Mg. value owing to increases in interstitial water.
(*b*) Calculated from Phosphate.

There are many nutritional factors which are stated to be the cause of rickets and these are recorded below. Although each is allocated a separate sub-paragraph yet in many instances there is close biological relationship.

(a) *Shortage of Calcium.*—This is one of the most important causes and is particularly evident in those breeds which grow very rapidly.

(b) *Disturbance of Phosphorus Calcium ratio.*—It has been found that with Ca: P of 6:1 or 4:1 severe rickets will occur, and even when the ratio is as low as 2·5:1 mild rickets may result. However, provided that the ratio is 2:1 or 1·2:1, the *level* high enough, and all other factors being equal, *e.g.*, adequate supplies of vitamin D, sunlight, etc., then there is little likelihood of the disease developing.

(c) *Phosphorus.*—There are certain factors governing the availability of phosphorus which are worth mentioning. A considerable amount (30 to 70 per cent.) of "plant" phosphorus is in the form of the calcium and/or magnesium salts of the hexaphosphoric ester of inositol called *phytin*. This substance is quite readily absorbed as such but unless the phosphate is split off by a specific enzyme known as *phytase* the substance will be excreted unchanged, and the phosphorus unutilised. *Phytase* has been identified in the intestinal mucosa of the rat, pig, chicken and cow, and it probably exists in other animals. As a good example, Mellanby (*loc. cit.*) quotes wheat germ, oatmeal and maize meal (Gyorgy) as being rachitic, and even if a dog is fed with large quantities of calcium (as carbonate) as well as with oatmeal then rickets will result. Morgan quoted by Earle[28] states that rickets in dogs is usually of the low phosphorus type due, not to lack of phosphorus, but to poor utilisation of phosphorus. An unusual case was reported by Kirk[29] in which rickets had persisted for over three years in a certain breeding kennel, during which time every possible anti-rachitic chemical and/or foodstuff had been lavishly administered to the dams and their whelps. It was only when everything was eliminated but just plain meat and dog biscuit that the disease at once cleared up and did not return.

(d) *"Anti-absorption"* substances.—Any materials capable of forming insoluble derivatives with either calcium or phosphate if fed in large quantities, will cause rickets. Citric and oxalic acids, both of which occur in green plants are rachitogenic in so far as they form insoluble calcium salts. In the same way insoluble phosphates are formed with iron, beryllium, tellurium, magnesium, lead and strontium. It is extremely unlikely, however, that these will ever be found in great abundance naturally, and in any case the animal would probably show symptoms of heavy metal poisoning first. Continued presence of liquid paraffin in excessive quantity prevents absorption of Ca and P from the bowel.

(e) *Effect of Potassium salts.*—Brumley states that large quantities of potassium salts are liable to prevent proper calcium absorption owing to the fact that they diminish the hydrochloric acid content of the stomach and thereby reduce the solvent medium for calcium salts.

(f) *Digestive disturbances.*—Any severe catarrhal infection of the stomach or intestine will reduce the amount of calcium absorbed and this will be eliminated in the faeces.

(g) *Condition of the bones.*—An inflammatory condition of the bones in which the blood vessels are enlarged will cause a local increase in circulation which will prevent the proper deposition of calcium salts in new bone tissue. Uncomplicated experimental calcium deficiency (studied only in the last few years) gives rise to a paralysis of the hind legs, widespread haemorrhages and extravasation of blood in the central nervous system. The bones also show considerable changes, the calcium content being half that normally found. Uncomplicated phosphate deficiency in rats results in early rickets, retardation of growth, deformed thorax and formation of renal calculi.

(ii) TETANY

The importance of the influence on the irritability of the neuromuscular system exercised by certain inorganic ions cannot be over-emphasised, *e.g.*, potassium increases irritability of muscles whereas a diminution of calcium has the same effect. Shohl (*loc. cit.*) states that an approximate mathematical relation between irritability and ionic concentration may be given by:

$$\text{Irritability} \propto \frac{[Na^+] + [K^+]}{[Ca^{++}] + [Mg^{++}] + [H^+]}$$

The tetany syndrome can result from several causes, *e.g.*, low calcium and high phosphate, low magnesium, high bicarbonate, toxic factors, etc. It often occurs, in practice, when vitamin D is inadequate and the Ca:P ratio shows high P and low Ca.

As regards tetany, one should also consider the effect of the parathyroids. Removal of these, or very much more rarely their disease, namely hypoparathyroidism, results in a lowering of the serum calcium well below the normal —10 mgm. per 100 ml.—tetany and death. The onset of tetany is fairly rapid and in this case would occur before rickets had developed. Phosphate intensifies the symptoms

but calcium, either by injection or by mouth, and intravenous parathyroid extracts have definite beneficial effects. Hyperparathyroidism induces opposite symptoms: there is a marked rise in serum calcium ; calcium and phosphate are drawn from the bones, and metastatic calcification occurs in the soft tissues. The outward symptoms are lethargy, muscular weakness, sickness and death. It is interesting to note that the rat appears to be very resistant to hyperparathyroidism and relatively large doses of the hormone are required to bring about the above symptoms.

(iii) Dental Hypoplasia

This important disease is related primarily to vitamin D deficiency, but extremely low dietary calcium also will cause the condition. The disease is known in puppies and there seems to be no reason why it should not occur in other small animals although the literature only reveals detailed information on the disease as found in the dog.

Whyte[30] describes dental hypoplasia " . . . .a condition which arises during the pre- and post-natal periods but before the eruption of the teeth."

Wright[31] in a full discussion of canine dental diseases pays some considerable attention to hypoplasia and describes some typical clinical manifestations. In some cases the teeth on eruption are found to be small and misshapen, in others the first, second and third pre-molars fail to develop. The enamel is of poor quality and is often stained a greyish-brown hue. Parts of the crowns may be denuded of enamel, and where there is this absence there will be either small circular pits or large irregularities involving the greater part of the crown, and in both cases exposing the dentine. In a footnote to his paper Wright quotes a case of an eight month old spaniel cross male in robust condition with no evidence of rickets. This dog had a severe illness during the third and fourth months of its life and the dental picture was as follows:

Upper Jaw: First and second molars on each side only. The teeth were small and showed enamel erosion (the left deciduous canine persisted).

Lower Jaw: Right side: An ill-developed, stained carnassial. Left side: The third permanent premolar and the carnassial. Both were stained. (Both deciduous canines and one deciduous incisor persisted).

Wright states that rickets is not a common disease in puppies, and that dental abnormalities in such affected animals do not form one of its prominent features. When hypoplasia does occur it almost invariably follows on a bout of canine distemper endured between the 10th and 20th weeks of life, which is the normal period for permanent tooth development. Whether this results directly from the presence of the distemper virus or is a temporary but more or less severe dietetic deficiency due to the puppies' inappetence during the illness is difficult to state.

One must bear in mind, however, that in all dogs the deciduous teeth are usually erupted and the crowns calcified at the time of weaning at five to six weeks. It would appear, therefore, that the young dog has a very strict requirement for an external source of the necessary dietary constituents (calcium, phosphorus, vitamin D) immediately after weaning in order to ensure proper calcification, and that any severe metabolic disturbance (*e.g.*, distemper) will in some way prevent the correct utilisation of one or all of these constituents.

It is often customary to refer to two types of hypoplasia, according to their severity. On the one hand, to the more obvious as the G-(Gross) type, and on the other hand, to the milder and less obvious (emphasised by Mellanby, and in previous years not given enough attention) as the M (Mellanby) type. Wright (*loc. cit.*) states that teeth deformed as the result of hypoplasia show no special predisposition to the accumulation of calculus, paradontal disease or caries, but Mellanby[32] appears to throw some doubt on this, certainly as regards human dental hypoplasia. In considering the more exact nutritional aspects reference is made to two conclusions of May Mellanby in her classical report on diet and teeth[33].

" When there is abundance of vitamin D present in the diet the intake of calcium can be brought very low and yet the structure of the teeth may be perfect or nearly perfect " —and on the other hand:

" When there is very little vitamin D present in the food the teeth are always badly formed whatever the amount of calcium and phosphorus. With a great deficiency of vitamin D the addition of calcium in the form of calcium carbonate, calcium phosphate or calcium hydrogen phosphate results in definite improvement in calcification. The improvement is most obvious when oatmeal forms the cereal and calcium carbonate the source of extra calcium."

As regards the influence of the bitch's diet on the teeth formation of the offspring, M. Mellanby[34] states that the teeth are affected in two different ways:

(Bitch A fed on diet of high, and Bitch B on a diet of low calcifying properties).

(a) " The actual calcification of the teeth taking place *in utero* of the foetuses of A is better than in the foetuses of B.

(b) After birth, if the diets of puppies of A and B respectively are of low calcifying qualities, the teeth of A's offspring—the well fed mother—stand up more effectively to the bad conditions and are better formed than those of B's offspring. In other words, it would appear that if once the mechanism of calcification gets a good start as the result of perfect conditions *in utero* it is more difficult to upset by subsequent bad conditions."

This, then, is a further example of the necessity of a full and adequate diet for bitches as well as for their offspring. As regards other mammals May Mellanby concludes:

" In view of the differences in the types of teeth of the dog, rabbit, and rat, the results obtained suggest the probability that the tooth structure of all mammalia is controlled, as regards calcification, by the same dietetic and environmental factors."

One other small mammal, the guinea-pig, not mentioned by May Mellanby to any extent, is the subject of an investigation by Howe, Wesson Boyle and Wolbach[35]. These authors found that when these animals were kept on a diet very low in calcium and vitamin D they developed typical rachitic conditions which, in the case of the young animals, included severe dental hypoplasia ; in the older animals, however, changes in the bones were obscured by skeletal growth, but those in the teeth were constant. The hypoplastic changes recorded by the authors were the G-type.

B. MAGNESIUM

This close chemical relative of calcium occurs as an integral part of the chlorophyll molecule in the plant and is therefore likely to be present in adequate quantities in practically all diets.

If rats are kept on a low magnesium diet they exhibit

extreme hyperirritability, tonic clonic convulsions and finally death. There is also retardation of bone calcification and marked dilatation of the cutaneous vessels. High magnesium prevents phosphate absorption with resulting faulty calcification of bone. Large injections of magnesium produce narcosis, anaesthesia and finally death.

C. SULPHUR

The present article is hardly the medium for a lengthy dissertation on the metabolism of this element which normally is considered under more " organic " aspects and which usually is associated with the amino acid constituents of the animal's dietary- protein. Natural deficiencies of sulphur are extremely unlikely but from the experimental viewpoints methionine is said to have increased hair production (Heard & Lewis[36]), and cystine supplements to have stimulated hair growth in a strain of rats with hereditary hypotrichosis. (Martin and Gardner[37]).

D. SODIUM AND CHLORINE

Deprivation of sodium leads, in experimental rats, to retarded growth lesions in the eye, leucocytic filtration in the cornea, blockage of the ducts and a transformation into the squamous type of the epithelium lining the inner margin of the lid. Sodium deficiency in dogs leads to a loss of weight, dryness of the skin, loss of hair and death eight weeks after the inception of the dietary restriction. No eye lesions were noted in the particular experiment. The retention of the sodium ion, together with chloride, appears to be closely associated with the deoxycorticosterone group of the adrenal hormones. This retention is also correlated with the loss of potassium, undoubtedly arising from the liberation of K ions from the negatively charged protein ions due to the proteolytic effect of the hormone group in question. There also seems to be a direct effect on the kidney which enhances the retention of sodium and the liberation of potassium. Domestic animals are probably less likely to suffer from sodium deficiency than are farm animals and in cases of doubt small quantities of common salt, or even salt lick, can always be added to the diet. Cuthbertson and Greenberg[38] have studied the effect of chloride deficiency on rats and have reported a decrease in the growth rate, a lowering of the serum chloride and extensive kidney damage in the late stages of this deficiency. It is usually impossible to refer to deficiency of sodium or chlorine separately ; both are usually studied together and in general, low sodium chloride intake leads to loss of body water, lowered production of milk and even an inability to make full utilisation of normal foodstuffs. The skin and eyes may show lesions and the fur may be poor.

E. POTASSIUM

As most domestic animals have access to adequate quantities of this mineral a deficiency disease is unlikely to arise. According to Rugamer, Elvem and Hart[39] deprivation of potassium led, in dogs, to " stiff neck " which proceeded to a general paralysis, together with a discoloration of the teeth and a haemoconcentration.

Kornberg and Endicott[40] in studying rats have reported a failure to grow normally—a prompt manifestation of the deficiency—oedema, and multiple lesions in many tissues followed by death. Histopathological studies reveal necrosis of the cardiac musculature and damage to the renal tubular epithelium.

There do not appear to be any authenticated reports of "natural " potassium deficiency diseases in the domestic animals.

F. IRON AND COPPER

These two elements are used, primarily, in the formation of haemoglobin, iron being incorporated in the haemoglobin molecule and copper acting as a catalyst to assist in the proper utilisation of the iron. Iron is best absorbed in the reduced (ferrous) state and in the alimentary tract the ferric iron of the diet is reduced to ferrous iron prior to absorption. Large quantities of phosphate will prevent the absorption of iron by the formation of insoluble ferric phosphate, and it has also been stated that organically bound iron is incapable of being absorbed as such. Absorption takes place in the stomach and/or small intestine—and any excretion (this is always very slight) is *via* the large intestine into the faeces. The anaemic condition need hardly be stressed as it is well recorded in the appropriate books of reference. The importance of copper in the utilisation of iron and to metabolism generally is now well known, although the condition of sway-back in lambs, which is a " natural " disease, does not appear to have been reported in the smaller domestic animals. The copper contents of milks, although small, are probably adequate for the animal's requirements as distinct from iron which certainly is not so. Nutritional anaemia resulting from iron deficiency in dogs is known but easily curable as the iron supplement can be supplied by including about 10 per cent. meat scraps in the diet and any reasonable amount of fresh meat (Earle, *loc. cit.*). The pregnant animal should be adequately provided with dietary iron to meet both her needs and also those of the offspring (see Part IV, B).

G. IODINE

Iodine deficiencies are widespread in the United Kingdom and all over the world. Goitre is known in a remarkable variety of creatures, ranging from the elephant to the trout, including most domestic and farm animals. There are several reports of goitre in small domestic animals amongst which the following may be quoted. Slipper[41] has described the case of a young fox terrier pup ten months old. This animal would stop suddenly, extend its head, snuffle and cough up mucus and froth. The thyroid was enlarged although an almost complete cure was effected by dosage with 2 grains potassium iodide daily and external application of potassium iodide solution on the throat. Pauer[42] has reported the cases of goitre in a six-year-old collie, several dachshund puppies and a fox terrier pup. In the case of the latter, cure was effected by internal and external administration of iodide and the author notes the fact that these particular puppies were reared by a bitch suffering from malnutrition. The collie and the dachshunds did not respond to treatment although these animals did not appear to suffer particularly in any other way. Mayall[43] has referred to several cases in dogs in the Bolton (Lancs) area. From the therapeutic point of view, dosage should be carefully controlled, for, although it has a definite beneficial effect in the case of iodine deficiency, yet excessive doses cause diarrhoea, abortion in females and bodily emaciation. It has been suggested that endemic goitre may be closely associated with dental fluorosis (Animal Goitre in England and Scotland: *loc. cit.*) in so far that observations have been made on the co-existence of fluoride rocks with goitrous (iodine deficient) areas. Undoubtedly there are other factors affecting the utilisation of dietary iodine and it would appear that calcium, when present in excess can prevent the absorption of iodine by reason of the formation of insoluble calcium iodide. A curious disease known

as "cabbage goitre" has been reported when feeding rabbits, etc., with large quantities of the leaves of certain members of the Brassica family. The precise nature of this goitrogenic substance is not definitely known and the two main suggestions as to its mode of action are: Firstly, that it stimulates increased production of the thyrotropic hormone from the anterior pituitary and secondly, that the substance is cyanide in nature and definitely interferes with the production and synthesis of thyroxine *in vivo*. Cabbage goitre shows pathological changes very similar to those found in human thyrotoxicosis (exophthalmic goitre). Only when there is prolonged feeding of cabbage on the goitrogenic substances is there production of the goitre. Small amounts as normally encountered in, say, human diet are very unlikely to produce any symptoms.

H. ZINC

This element is present in the hormone insulin and in the enzyme carbonic anhydrase. It is essential to animal life and although there appear to be no reports of a natural deficiency, experimental deficiency causes, in rats, retardation of growth and some impairment of fur formation. Histopathologically there are inter- and intra-cellular oedema, hyperkeratinisation, localised epidermal thickening (Follis, *loc. cit.*) and also a tendency for leucocytic infiltration in the corneas, as in sodium deficiency.

I. MANGANESE

It has been shown by Smith, Medlicott and Ellis[44] that deficiency of this element interferes with the development of the skeletal system of rabbits as it does in poultry (perosis in chicks). This interference is less marked in the case of rats than it is with poultry or rabbits. In addition it would appear that a deficiency also causes some upset of the reproductive systems in so far that rats kept on a manganese deficient diet develop irregular oestrous cycles, testicular degeneration, and a failure on the part of the weak offspring to suckle.

J. COBALT

This element appears to have a specific action in the formation of blood and is more widely associated with deficiency diseases in various parts of the world of sheep and cattle (enzootic marasmus, coast disease, pining, etc.). Should it be found in smaller animals it is suggested that the changes would include anaemia, general debility, loss of weight, etc.

K. MOLYBDENUM

The presence of this element in the so-called "teart" pastures of certain parts of Somerset. Warwick and Gloucester gives rise to a condition in sheep and cattle known as scouring, characterised by general loss of condition, production of watery, ill-smelling dung, staring of the coat of cattle, and a drop in milk yield. It is not known whether this disease affects domestic animals in the "poisoned" localities but it seems very unlikely unless they utilise large amounts of the natural vegetation of their diets.

L. SELENIUM

The presence of this element—a near relative of sulphur—in the soil and herbage of certain parts of the U.S.A. gives rise to what has been termed "alkali disease." This is characterised by decay of hoofs, loss of hair, lameness, collapse and finally death. It appears to affect all domestic animals in the locality.

K. FLUORINE

This element is found as a normal "trace constituent" of bones, most foods and in certain grades of rock, etc. In trace form it appears to be harmless but if larger quantities are found in the diet the effects will be a severe mottling of the teeth (dental fluorosis) often resulting in decay, a loss of general bodily condition, and with large doses—death. (See Agate *et. al.*[45].)

PART IV

MINERALS AND REPRODUCTION

A. General Considerations

One of the most important periods in an animal's life as far as susceptibility towards nutritional diseases is concerned, is during the rapid growth period immediately following birth. Whilst living on its mother's milk a young animal can grow and thrive provided, of course, that the mother has all that she requires in her diet both for her own needs and for the milk which she is constantly producing. Failure of the young to grow normally, or even to survive, can often be traced to deficiencies in the mother's diet, as in the case of manganese, deficiency of which in female rats causes the production of weakly and often dead offspring. The principal elements are normally present in adequate quantities although iron, present only in traces, is inadequate for the needs of the growing animal. To counter this the mother lays down in the foetus during gestation supplies of iron in its liver but after a time these have to be supplemented from outside sources and unless this is strictly attended to nutritional anaemia will result. The copper and iodine of the mother's diet are also very important and lack of these will be reflected, pathologically, in the foetus.

Growth rate is also a relevant factor and the classical researches of Bunge and Abderhalden resulted in the thesis that the composition of milk is related to the time required for the young to double its birth weight; the more rapid the growth the greater the concentration of minerals in the milk. This is illustrated in Table VII below.

Table VII

Growth and Milk Minerals

Species	Days required to double birth weight	Protein	Ash	Ca	P
Cow	47	3·5	0·70	0·12	0·09
Dog	9	7·4	1·33	0·32	0·22
Rabbit ...	6	14·4	2·50	0·65	0·43

This Table indicates that the rapid growth of the rabbit is well catered for in the concentrated milk of the does, and from the more practical aspects of breeding, etc., the provision of adequate mineral supplements at all stages will be obvious.

B. Detailed Aspects

From the moment of conception it is essential that the foetus is supplied with sufficient nutrient materials and this

means that during gestation as well as during lactation the female must have adequate supplies to deal with both her own needs and those of her offspring. With respect to calcium, phosphorus and vitamin D, E. Mellanby[46] has shown that if bitches are fed during pregnancy on diets which are rachitogenic then the offspring will have a greater tendency to develop this disease. The tendency is not entirely removed by a period of good diet and may become evident at a later period. There is also the possibility of abortion, and even (in severe deficiencies) of the death of the bitch.

If her own food is deficient in calcium, etc., the gestating mother will draw on her own reserves, but there is quite obviously a limit to this and sooner or later in cases of severe dietary deficiency serious symptoms will occur. In the case of prolonged calcium deficiency the symptoms may include (in the case of the dog), haemorrhage, paralysis of puppies if and when born and possibly in the hind legs of the bitch herself, inflammation of the gastro-intestinal tract and even "osteoporosis." Milk, of course, will be poor in quantity and quality.

A balance sheet of the income and output of calcium, phosphorus and magnesium in a bitch has been prepared by Toverud and quoted by McCay (*loc. cit.*) and is given below in Table VIII.

Table VIII

Mineral Balance Sheet of Bitch Fed on Low Calcium, Phosphorus and Magnesium Diet

Details	Amounts (in gms.): Calcium	Phosphorus	Magnesium
1. Total intake during gestation	10·5	20·4	8·9
2. Loss through urine and faeces	16·0	33·8	7·8
3. Total loss through 4 foetuses	9·4	5·8	0·3
Total loss during gestation ...	25·4	39·6	8·1
Balance at end of gestation ...	—14·9	—19·2	0·8
1. Intake through food during lactation	7·3	12·2	4·2
2. Intake from puppies' faeces during lactation	4·0	2·7	0·8
Total intake during lactation	11·3	14·9	5·0
1. Loss through urine and faeces	10·0	13·2	2·6
2. Loss through secreted milk...	30·9	20·6	1·4
Total loss during lactation ...	40·9	33·8	4·0
Balance at end of lactation not counting gestation ...	—29·6	—18·9	0·9
Balance at end of lactation counting gestation ...	—44·5	—38·1	1·7

Amongst the many elements which are essential to the growing and adult animal three are worthy of mention in so far that a reasonable amount of information is available about their relations to foetal nutrition. These are iron, iodine and manganese.

Since a puppy at birth may contain as much as 79 mgm. of iron in its body it is obvious that a large call will have been made on the mother's supplies, for although the bitch will practically cease transferring iron to her offspring after birth, she will have had to supply them during the gestation period. It is therefore essential to ensure that adequate quantities of iron are available in the mother's diet during gestation. There are several good sources of iron that can be incorporated in the diet and amongst these are liver (excellent), and crude molasses which, although not over-palatable, is a fair source. Finally, it is emphasised that, once born, a puppy must draw on its own iron reserves until it is weaned, for little iron is present in any milk, and no amount of increasing the iron in the bitch's diet will increase the trace quantities of this element in milk.

In the previous section devoted to iodine a few cases of goitre in small animals have been reported, but nevertheless it is a rare disease. E. Mellanby has reported some very interesting results on the importance of iodine to the bitch. If bitches are kept under laboratory conditions and fed on diets which are adequate except for the iodine contents, the young when born will exhibit enlarged thyroids; these enlargements are not so pronounced in the first generation but if the diet is maintained the subsequent litters will show very hyperplastic thyroids. If iodine is administered during any part of the experiment the thyroids of the next and subsequent litters will be nearly normal and much reduced.

These results are illustrated by the experiments of E. Mellanby set out in Table IX.

Table IX

Experiment on the Production of Goitre in Dogs

Litter No.	Size of puppies' thyroids at weaning	Average weight of offsprings' thyroids at death	Age of offspring at death	Number of puppies per litter
1	Large	23 gms.	6 months	4
2	Very large	230 ,,	2½ years	4
3	,,	55 ,,	5 months	3
	Bitch given doses of 0·2 gm. potassium iodide between litters 3 and 4			
4	Small	6 gms.	10 months	5
5	,,	7 ,,	1¼ years	4
6	,,	7 ,,	(*a*)	6

Note—(*a*) 2 still alive at this stage of experiment.

From his experiments Mellanby deduces two main facts:

Firstly, "That the maternal organism is capable of passing on a sufficiency of iodine to the embryo if she herself is given a reasonable supply."

Secondly, "That most ordinary foodstuffs are so iodine deficient that they do not afford a sufficient supply for the mother to pass on to the embryo. Under these circumstances the thyroids of the offspring become hyperplastic."

One comment can be made on this last deduction and that is that few hyperplastic thyroids appear in naturally born young animals, at least in this country, and one feels, therefore, that perhaps Mellanby's second conclusion is a little over-pessimistic. In any case to ensure healthy thyroids the gestating bitch can always be supplied with two or three drops of Lugol's iodine per week in her drinking water.

Reference has already been made to manganese and although no clinical report has been seen on the results of its deficiency in small animals the experimental work seems sufficiently convincing to establish it in an essential rôle in all phases of reproduction.

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ARTIFICIAL INSEMINATION SERVICE FROM "COLOUR-MARKING" BEEF BULLS

The existing arrangements whereby farmers are provided with a free service of artificial insemination from "colour-marking" beef bulls will end on March 31st, 1950. After that date a charge of 12s. 6d. per first insemination will be made. This charge will cover two further inseminations of the same cow if the first is unsuccessful, and inseminations in excess of three, if required, will be charged for at the full rate (normally 25s.) as at present. This arrangement will operate until March 31st, 1951, when Parliamentary authority for the scheme will expire.

ETHYL CHLORIDE IN VETERINARY ANAESTHESIA

BY

E. O. LONGLEY, B.Sc., M.R.C.V.S.

Ethyl chloride has largely been ignored in veterinary anaestnetic practice, although it is an agent of unique value in its proper contexts, and one would have tnought that its wide use in paediatrics, so akin to work on animals, would have constituted a recommendation. Wright (1947) gives it only passing comment:—"Deschambre employs ethyl chloride for anaesthetisation of the kitten and McCunn speaks well of nitrous oxide. The writer has used both, but in his opinion they are inferior to ether": and later:—"Ethyl chloride and nitrous oxide have their champions, but in the author's opinion they are very inferior to ether." Yet in at least two outstandingly important respects, its safety and its rapidity of action, ethyl chloride is the indisputable superior of ether. And other strong recommendations of ethyl chloride, as compared with ether in particular, are that its vapour is not comparably irritant, and that its smell is not resented by animals.

Moreover, it must be questioned whether any such simple comparison of these two agents is entirely legitimate. Agents suitable for the induction of anaesthesia, and those by their nature more appropriate for maintenance, have distinctive merits, and cannot so simply be compared. Thus ether has few equals as a maintenance anaesthetic, but it is the last agent for choice for purposes of induction in animals owing to the prolonged stage of delirium. In complete contrast, ethyl chloride is an exemplary agent for induction, but is not recommendable for maintenance since its extreme potency demands the whole-time attention of a skilled anaesthetist, for safety and the maintenance of a steady level of anaesthesia, and also muscular relaxation is not good (personal observation). As an agent for induction by inhalation, however, it is unequalled, and it has had routine use for this purpose by the writer, and exceptionally for maintenance, on over 50 occasions and in many species, these including the domestic cat and dog, and a wide variety of wild mammalia and birds, to excellent effect and with never the threat of a fatality. For this purpose it is the incomparable superior of, and should assuredly replace, chloroform.

Manufacturers' Pack.—Ethyl chloride has a boiling point of 12·5°C. It is thus highly volatile and properly a gas at summer temperatures, but may, under light pressure, be preserved in liquid form with considerable advantage in compactness and handling (compared with cylinders of gas-proper, as of nitrous oxide). It is available commercially* (1) in the familiar glass ampoules with graduated scale, for spraying, and of capacity 50 and 100 c.c.: (2) in similar copper containers, ungraduated: (3) in 2 kg. copper-containers for hospital use, from which it may be run off as a liquid, *e.g.*, into a measuring cylinder, or used to refill the copper containers above, with considerable economy. It should be added that the very volatility of the liquid allows of its being handled and poured as a liquid in this manner without significant loss even in summer since the heat of vaporisation so rapidly reduces the temperature that the process slows down to negligibility, as with CO_2—snow.

SAFETY

According to Macintosh (1947), ethyl chloride in competent hands is the safest of all anaesthetics. The *South African Medical Journal* (1936), reporting the human

* From Messrs. Bengue and Co., Ltd., Mount Pleasant, Alperton, Wembley.

mortality-rate for all anaestnetics for the five-year period 1931-35 and covering a total of 203,159 cases, records a mortality-rate of one in 6,907 for ethyl chloride. Ether registered one in 3,166 and chloroform accounted for one death in 560. Here ethyl chloride is more than twice as safe as ether, more than 12 times as safe as chloroform. Still more impressive figures are adduced by Hirsch (1927) for etnyl chloride, *viz.*, two series of 22,000 and 43,433 cases respectively without casualty. Again: " In experiments on animals it was found that to stop the heart it (ethyl chloride) had to be presented about 19 times more concentrated than chloroform " (Hirsch, *op. cit.*). Thus the well-known risk of syncope with induction by chloroform may be discounted. Such data are in entire accord with the formulation of Macintosh, and ethyl chloride emerges as the safest of all agents.

Methods of Use and Applications

Ethyl chloride, being so highly volatile, is best applied when possible in an enclosed space. Wright (*op. cit.*) advocates the use of a bell-jar for chloroform anaestnesia in the kitten. The present writer cannot agree more in respect of the use of all-glass receptacles, and the bell-jar would be as serviceable here, but for general duty the present writer prefers rectangular, all-glass battery jars (Government surplus). The special advantages of glass are, of course, that animals can see out and suffer no fear or " claustrophobic " reaction, this favouring smooth, quiet induction. They remain, conversely, in the clear view of the anaesthetist. The jars in question are robust and readily made nygienic, are equally serviceable for the adult animal, and fractious subjects once inside present no problem of control. And, as is not possible with the bell-jar, the anaesthetic may be simply poured directly in without the use of cotton-wool. The additional advantages of this last practice are that the anaesthetic may then be used in known (optimum) vapour concentrations as below, and evaporates immediately (without the delay and the wastage attending the use of wool) to produce the desired concentration. The advantage of this is considerable.

In the dog, the agent may be administered from wool in a mask in the ordinary way. Alternatively, a simple " bomb " may be used on the principle of the " ether-bomb " (Macintosh and Bannister, 1943). This requires simply the attachment of the rubber connection of the mask to the all-metal form of container already mentioned, which rests in the beaker or jar of warm water. Or the inhalation apparatus devised by the writer for chloroform-ether anaesthesia (Longley, 1947) may obviously be used, substituting ethyl chloride for the chloroform and with settings of the taps which can readily be worked out on first principles, this being the method of choice where maintenance anaesthesia with ether is to follow, on account of the ease of the change-over.

Optional Concentration of Vapour.—The only data on this issue available in the literature was Hirsch's (*op. cit.*) reporting Konig to the effect that in animals, 10 per cent. vapour took six minutes to induce anaesthesia, while with 50 per cent., one minute sufficed.

An investigation of this matter by the writer (in rats) did not confirm Konig's data. Indeed, a concentration of 10 to 12 per cent. was actually the most efficacious, effective in one to two minutes. Lower concentrations led to a prolongation of the period of induction while with higher concentrations, there was similar (slight) retardation, but resulting from slight inhibition of the respirations, this reducing the anaesthetic intake and off-setting the advantage of the increased concentration.

The capacity of the jar to be used being known, it becomes a simple matter to calculate the volume of liquid to be added to attain the appropriate vapour-concentration. 1 c.c. of the liquid provides some 340 c.c. of the pure vapour at room temperature or 3·4 litres of the requisite 10 per cent. vapour-air mixture. The jar used by the writer for small subjects (including the adult domestic cat) was of dimensions 36 × 30 × 15 cm. (14 × 12 × 6 inches) or of capacity 17 litres. Thus 5 c.c. of the liquid agent poured into this vessel provided the optimum 10 per cent. of vapour.

With the agent available in bulk as described, the expense of anaesthetising a cat or other animal as above is slightly more than 1d.

Procedure and Course of Events.—The animal is placed in the jar, the requisite amount of ethyl chloride measured out, poured in, and the jar covered. For some 20 seconds no effects are apparent. The subject then makes several turns while the action of the agent becomes increasingly apparent, and for a duration of one to two minutes. Wild delirium and struggling are conspicuously absent. The animal then suddenly loses consciousness and collapses in light anaesthesia. Diminution in the induction-time may be effected by adding (as from a " Sparklet " resuscitator) a whiff of CO_2, which visibly promotes the respirations and hence the anaesthetic intake, at the same time distributing the vapour uniformly in the chamber. But this is inessential.

Careful scrutiny of the animal is now important, since the level of anaesthesia deepens rapidly, and no more than 30 to 60 seconds will be required for the attainment of the deepest level. The criterion *par excellence* is the respirations, which become increasingly more rapid and shallow. When these approach abeyance, the subject is removed from the chamber without delay, in deep anaesthesia, the duration of which will be for two to four or five minutes. These data are similar to those for man (Hirsch). This period suffices for the necessary interference which may be simple inspection, as of the pharynx or abdomen ; castration ; dental extraction ; incision and evacuation of abscesses, etc. ; or the change over to a maintenance anaesthetic, as below. It may be remarked that anaesthesia with ethyl chloride may pass to the point of bulbar paralysis without cause for anxiety, for a few seconds' (*sic*) artificial respiration will invariably restore the respirations, owing to the ultra-rapid elimination of this agent. The anaesthetic stage is followed by a period of analgesia and quiescence (except in some cats). It is an interesting observation, with practical implications, that those subjects succumbing most readily (*i.e.*, in 40 to 60 seconds) are generally the longest to recover, while those more resistant recover earlier.

These induction-times should be compared with those for ether or chloroform, where ten minutes or more may be required for the attainment of a serviceable level of anaesthesia, and during which time the animals are commonly enough delirious and throwing themselves about.

For more prolonged anaesthesia, ether by inhalation may be superimposed ; no process could be more expedient and smooth than this, and the method is incomparably superior to the usual chloroform-ether technique.

The writer has also employed the period of anaesthesia with ethyl chloride to superimpose durable anaesthesia by means of the barbiturates. It is here that the evanescence of the action of this agent is again uniquely valuable, allowing addition of the barbiturate to be made in perfect safety with no delay, as would not be possible with any other

agent. With the syringe charged and ready, the injection-site is rapidly clipped and shaved and the needle inserted. At the first sign of returning consciousness, which will more or less coincide with the completion of these preliminaries, the injection proceeds as for a normal conscious animal. This technique has particular and obvious value for working single-handed and/or with troublesome subjects. Thus it has been employed by the writer with complete satisfaction in powerful and vicious monkeys and, using ethyl chloride alone, castration in the cat may be accomplished with convenience, and entirely unassisted, and with a delay of no more than a minute or two for anaesthesia. With cats there may occur delirium for the space of half a minute or so, during the recovery phase, the best remedy for which is the routine placement of these animals for the minute or so for (post-operative) recovery, back in the anaesthetic chamber (cleared of the anaesthetic by simply blowing into it) or, of course, into a basket. This effect does not follow the use of ethyl chloride and a subsequent anaesthetic.

Ethyl Chloride for Euthanasia.—For the destruction of animals in lethal chambers, ethyl chloride used as described should certainly be preferred to chloroform or ether. After the minute or two necessary to accomplish the anaesthesia, the best practice is to administer an intrathecal (intramedullary) injection of chloroform, methylated spirits, hot water, or other convenient lethal agent (Longley, 1934). This is entirely conclusive and avoids the alternative of leaving the animal in the chamber, etc. Advantages of ethyl chloride in these circumstances are its speediness and the absence of significant struggle, both strong recommendations in circumstances where the owner is a witness and/or the animal troublesome.

Ethyl Chloride for Local Analgesia

The total freezing of operation-sites by the ethyl chloride spray is not considered good anaesthetic practice, owing to the considerable pain of the thawing-out process. But used more moderately this procedure has no prohibitions, affords valuable *analgesia*, and the applications become multiple. In all nervous animals, large or small, due to receive injections and likely to resent the prick of the needle, its application will avoid all struggle. It is, used in this way, a most expedient substitute for the injection of local anaesthetic over the jugular vein in intravenous work in horses (or cattle) and as is recommended by Wright (*op. cit.*). Instead of the routine of such an injection all that is required is the application of the jet of the spray to the site until the appearance of " frost " on the coat, this occupying a few seconds only and being effected simply by pressing the trigger. The treatment is quite unsensed by the animal, yet provides analgesia which will efficiently mask the intromission of the needle. The spray itself is conveniently carried and replaced after use in the operator's coat pocket, and for such duty in veterinary work the all-metal bulbs are obviously to be preferred. Other applications springing to mind are, *e.g.*, as a preliminary to nerve-block by injection in nervous horses, for the diagnosis of lameness ; similarly, for teat operations in the cow, etc.

This practice should have far wider recognition and adoption in veterinary work, if only for its great convenience.

Summary

(1) Ethyl chloride is an anaesthetic agent with unique properties, which has been largely neglected in veterinary work. In general anaesthesia it is pre-eminent for induction. Locally. it should have recognition and wider usage as an analgesic.

(2) In competent hands it is the safest of all the inhalation anaesthetics, particularly appropriate for cats or other small animals. It is also an excellent general anaesthetic in birds.

(3) The induction period normally occupies only one to two minutes and there is negligible excitement or struggling.

(4) It is best applied within a rectangular glass chamber at a concentration of 10 per cent. No toxic effects are recognisable.

(5) Ether by inhalation, or the barbiturates intravenously, may be superimposed, with complete safety and great convenience in working single-handed.

Acknowledgments.—I am indebted to Messrs. Bengué and Co., Ltd., Mount Pleasant, Alperton, Wembley, for supplies of the anaesthetic and the communication of certain literature.

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SUCCESS OF MALARIA CONTROL CAMPAIGN IN CYPRUS

The successful completion of the three-year campaign in Cyprus to rid the island of the malaria-carrying mosquito was officially announced on January 9th, 1950. The then Secretary of State for the Colonies, Mr. Creech Jones, sent a message to the Governor of Cyprus, Sir Andrew Wright, congratulating " all those concerned in this splendid victory over Cyprus' age-old enemy, the malaria-bearing mosquito."

Reviewing the achievements of the campaign, Mr. Creech Jones pointed out that before the war anything up to 18,000 cases of malaria a year were recorded in Cyprus ; by 1947, at the end of the first year's campaign, the cases numbered less than 2,000 ; 1948 figures showed 400 cases and, in 1949, there were just over 100, not one of them resulting from new infection. Infant mortality, which had been mainly due to malaria, has also dropped in the past seven years—from 180 per 1,000 live births in 1942 to less than 70 in 1949.

Three different species of mosquito have been destroyed by means of a campaign consisting mainly in DDT spraying of all possible breeding grounds, in difficult mountainous country. Operations were largely carried out by Cypriots themselves, under the direction of Mr. Mehmed Aziz, the island's chief health inspector, who studied under Sir Ronald Ross. The total cost of the campaign was about £300,000, an allocation under the Colonial Development and Welfare Act providing £20,000 and the rest being raised locally.

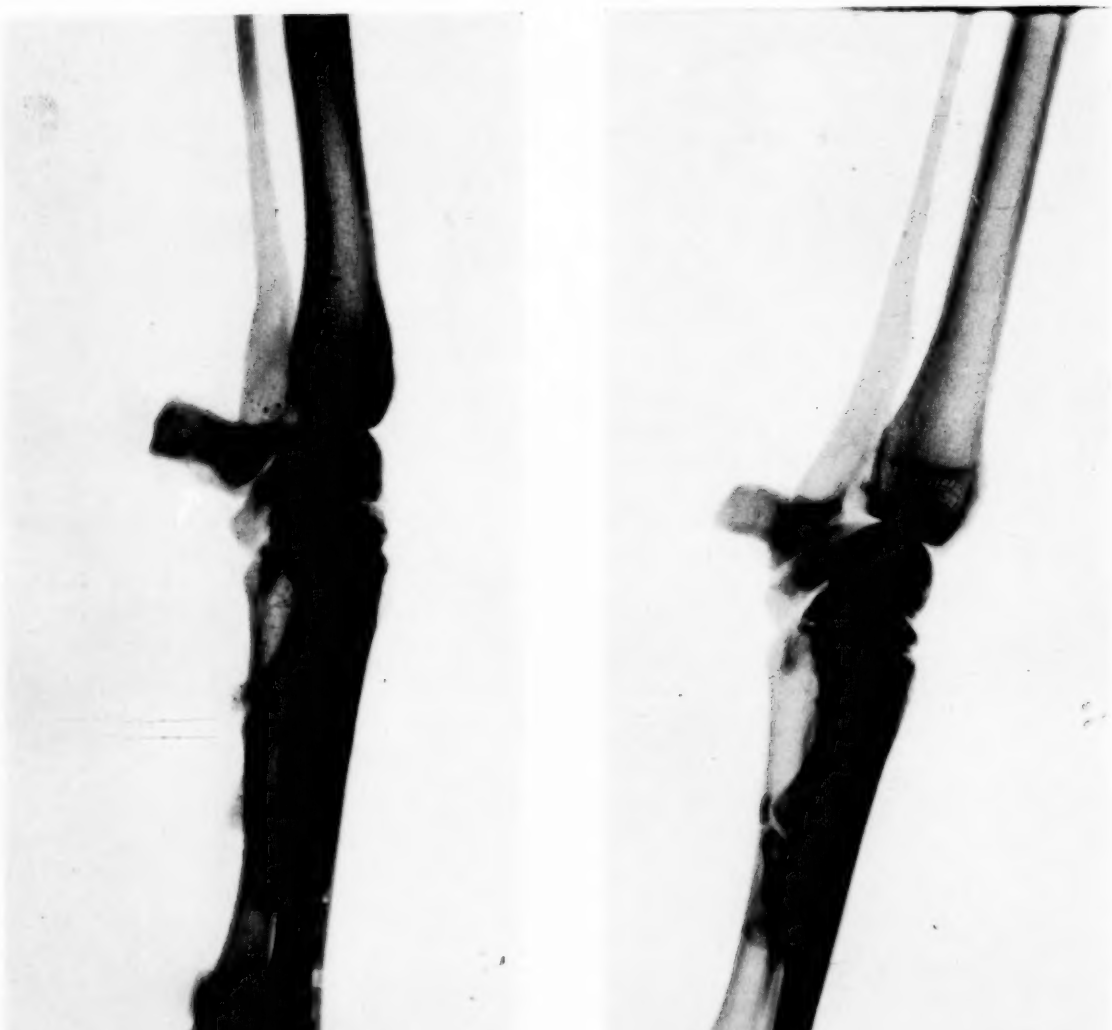
News of the Mauritius Campaign

In his review, Mr. Creech Jones referred to the similar campaigns being organised in other Colonial territories, including British Guiana, Sierra Leone and Mauritius. A recent report on the progress of the mosquito eradication scheme in Mauritius, under the direction of Dr. M. A. C. Dowling, describes how not only houses but every type of building from churches and factories to cattle sheds have been sprayed with insecticide. Since this systematic spraying was started the mosquito population has dropped sharply, with a corresponding drop in the Island's death-rate. In the 15 years, 1934-48, the death-rate in the first six months of each year, when malarial infection is highest, averaged 28 per 1,000 ; for the same period in 1949 it was under 17, despite an unusually wet season, which normally favours a high malaria rate.

* * * * *

Weekly Wisdom

The freedom of science is no isolated question. It is one facet of the wider problem of the preservation of a free society.—*Nature* (Editorial, February 25th, 1950).



A. B.

Radiographs of a successful case showing (A) the fractured piece of bone on the distal surface of the Pisiform bone and (B) the same subject six months after operation.

CLINICAL COMMUNICATION

FRACTURE OF THE ACCESSORY CARPAL (PISIFORM) BONE IN THE RACING GREYHOUND AND ITS REPAIR

J. K. BATEMAN, B.Sc., M.R.C.V.S.,
NORTHAW, POTTERS BAR, MIDDLESEX

The carpus of the racing greyhound is singularly free from trouble with the exception of damage to the pisiform bone. Sprains of the multiple joint do occur, but these are relatively rare as a wonderful cushion is provided for the many stresses put on it. Really serious trouble is encountered, however, in the pisiform bone and this probably more often in the off limb than in the near one.

Damage, on X-ray examination, appears to be small. A thin small shell of bone (Fig. I.) becomes detached from the distal surface and the dog finishes lame. In a few days he becomes sound and will gallop well, but invariably finishes lame again. Recovery is unsatisfactory. The only successful cases I have had until now have been those in which nine months rest from racing have been given and when unlimited freedom has been ordered. Such a case may race again, but the dog has lost a large part of his racing life and much of his speed, too, has gone.

Recently, however, I have discovered a new method of approach and the two dogs which have been subjected to this treatment have returned to racing within three months. They finish quite sound after their races.

The treatment consists of the resection of the *M. Abductor Digiti Quinti* on the injured limb. Study of the anatomy of the part reveals that this muscle alone has its origin on the distal surface of the pisiform bone and that it is obviously impossible for a detached fragment of bone to become reattached upwards, so long as there is elastic tissue pulling it away.

The operation is simple. A local anaesthetic is injected in the area of the lateral surface of the pisiform bone. Two strong bands of tendinous tissue passing distally and laterally from the pisiform bone can be felt plainly (Fig. II). The incision of about 1 inch in length is made directly over the inter-tendinous area (Fig. III), and in a ventral direction. A director is inserted, as shown in Fig. IV, and the muscle is raised.

Confirmation that the correct part is over the director is forthcoming by the evidence of tension on the tendon which runs as a fine thread down the lateral edge of the fourth metacarpal bone and ends in the region of the fourth metacarpo-phalangeal joint at its posterior aspect.

When satisfaction is achieved and all the body of the muscle is above the director, a pair of artery forceps are applied to the muscle belly and about an inch is snipped out of its length. The skin wound is closed and healing takes place by first intention.

Even before external healing is evident the dog may go on walking work and it is quite feasible to order galloping on the straight in a month's time, gradually increasing the amount until finally after two months he can be galloped 300 yards on the straight twice weekly. It is then only a short time before trial on a track may be ordered.

On manipulation of the affected carpus, it is found that whereas, before operation, flexion of the carpus evinced considerable pain and only limited movement was possible, it is now simple to bend the main pad of the foot right back until it rubs on the flexor muscles and no pain whatever is evinced. One cannot detect any ill effect from the removal of the *M. Abductor Digiti Quinti*. On comparison, the two fore feet seem alike and though I have done two cases only, I feel that this simple operation has opened the way towards ending a state of affairs which has so often terminated the racing career of many useful performers.

FIG. I

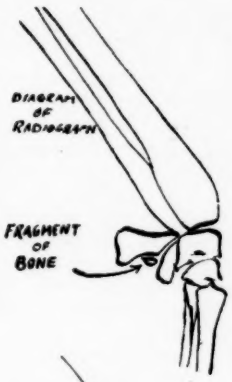


FIG. II

FIG. III

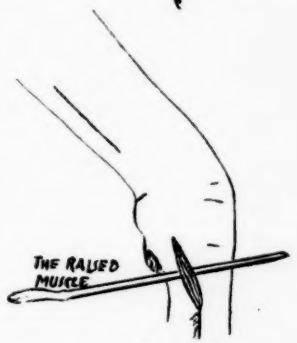


FIG. IV

Radiographs taken of the two successful cases before operation and after the greyhounds have recovered show, in both cases, that healing of the fragments to the main bones has taken place and obviously there is little chance of their becoming detached again.

Acknowledgments.—I am much indebted to Messrs. John Going, M.R.C.V.S., and Ian Mackinnon, M.R.C.V.S., for their valued help and encouragement during the above work; also for their radiographic assistance and that of Colonel Charles Holland, M.R.C.V.S.

ENGLISH GUERNSEY CATTLE SOCIETY'S SALE FOR ADVANCED REGISTER ONLY

"The English Guernsey Cattle Society's experiment of holding a sale confined to animals of Advanced Register standard only, received excellent support from breeders at Reading," reports *The Farmers' Weekly*, adding, "True, there were a number of absentees and other lots were unsold, but the level of bidding for the best and the averages can only be regarded as satisfactory. It seems clear that such a sale, held periodically—not too often, of course—might well become one of the most popular features of the Guernsey year."

The actual conditions were that all females entered must conform to the following standards: (*a*) having completed a lactation and reached A.R. standard, or (*b*) not having completed a lactation, the dam must have reached A.R. standard.

In the case of bulls all entries were required to be from parents qualified in the A.R. and whose dam and sire's dam have given at least 10 per cent. above the requirements in both milk and butterfat.

ABSTRACTS

[Control of Infection with the Bovine Tubercle Bacillus. FRANCIS, J. (1950.) *Lancet.* **1.** 1. 34.]

This paper gives a comprehensive review of the relationship between tuberculosis in cattle and tuberculosis of the bovine type in man. The pathogenesis, natural history, incidence and epidemiology of the disease in cattle are discussed fully. In the section comparing the human and bovine types of *M. tuberculosis* it is pointed out that the bovine tubercle bacillus can produce disease in a wide range of species, is less specialised in its pathogenic properties, and is probably developmentally more primitive than the human type. It appears, however, that although the bovine type is as virulent as the human type once it is localised in the human lung, it has greater difficulty in becoming so established and therefore exhibits a lesser power of spread from man to man. The ingestion of bovine tubercle bacilli in milk is one source of human infection that can be prevented. Although the number of positive milk samples as determined by the biological test in guinea-pigs remains high in this country, the decrease in non-pulmonary tuberculosis in children may indicate that veterinary inspection of herds has reduced the weight of infection. In Great Britain little attention has been paid to the risk of respiratory infection from cattle, but it has been shown in Scandinavia that people working with tuberculous cattle are in danger through exposure to direct aerogenous infection, chiefly from the dust of the cowsheds.

Concerning the effect of tuberculous milk on the epidemiology of human tuberculosis, an inverse relation exists between the incidence of tuberculosis in cattle and the death-rate from tuberculosis in man. It may be that exposure to bovine tubercle bacilli in milk provides a protection against the more dangerous respiratory infection in later life. The author describes the progress in the control of tuberculosis in cattle in the U.S.A. and in Denmark. The control measures and tuberculosis-eradication schemes adopted in Great Britain are described fully, including tuberculin tests and the various types of tuberculin employed, whilst accredited, attested and T.T. herds are referred to in detail.

In addition to reducing the incidence of bovine tuberculosis in man, eradication of tuberculosis in cattle would increase the efficiency of meat and milk production. For this reason close collaboration between the medical and veterinary professions is eminently desirable.

C. A. E. B.

* * * * *

[Newcastle Disease Immunisation with Live Virus. BEAUDETTE, F. R., BIVINS, J. A., & MILLER, BARBARA. (1949.) *Cornell Vet.* **39.** 302–334.]

Variations in virulence are common in different strains of the same virus. Such variations occur naturally, or may be produced by cultivation of the virus in conditions not optimally favourable. The latter method is usually tedious, and the authors decided to investigate the pathogenicity of a large number of strains of Newcastle disease isolated from natural outbreaks.

A preliminary screening of these strains resulted in the retention of eight strains of 205 tested, for more thorough examination. These strains were subjected to further trials in the field, the non-diluted virus being applied by the "stick" method of vaccination, or by the intra-muscular injection of 0·2 c.c. of a 1 : 100 dilution. It was found that a loss of 1·73 per cent. occurred after the vaccination of 2,884 chicks by these methods. The immunity of some of the survivors was challenged 15 days later with a dose of 0·2 c.c. of a 1 : 16 dilution given by the alternative method to that used for the original vaccination. Of the 578 birds so tested, six died, but only one from Newcastle disease.

Further tests were made, so that eventually a total of over 83,000 birds were vaccinated on 20 commercial farms with a loss of 1·82 per cent., not always attributable to Newcastle disease. It was considered that no carriers resulted from these vaccinations, but that a flock so treated is a potential source of infection for about three weeks.

Vaccination of batches of chicks after the disease had appeared resulted in a marked reduction in the mortality rate. The best age for such treatment is at four or more weeks. In producing birds, vaccination results in a drop on the fifth or sixth day, with a return to normal production about two weeks after vaccination. There is an extensive summary of previous work.

J. G. C

REVIEW

["Clementson's List of Scholarships, Fellowships and Grants to Students and Research Workers" Volume 1, 200 pages, 21/– Net. Clementson's List Ltd., 2 Post Office Terrace, Cambridge.

The Report of the British Council, the year 1948–49. The British Council, 3, Hanover Street, London, W.1]

The recently published "Clementson's List of Scholarships, Fellowships, and Grants to Students and Research Workers" comprises 20 "numbers" relating to various professions and sciences which together comprise volume I of the list.

"Number" 15 is devoted to veterinary science. It is not the fault of the editors if this list consists of one page whereas we are told other lists consist of two to 30 pages. It is evident that the editors have tried to give as comprehensive information as possible about every type of scholarship, fellowship and grant available for veterinary students and graduates. The paucity of the material is but a reflection of the paucity of the awards available for veterinarians.

In making this comment it is interesting to read the Report of the British Council for 1948-49.

The basic purpose of the Council is to present British life and achievement to the countries of the world whether in the Commonwealth or not. Examination of the report shows what a very wide field is covered.

One reads the report, however, in vain to find any direct reference to veterinary work in Great Britain or to its presentation to interested countries.

For example, on page 22 are enumerated the number of scholarships awarded by the British Council. It is stated:

> "A broad classification by subjects of study pursued includes: Agriculture, 15; Architecture and Town Planning, 5; Art, 14; Drama and Music, 9; Education and the teaching of English, 75; Engineering, 25; Journalism, 3; Law, 10; Medicine, 75; Science, 54; and Sociology, 25."

There is no mention of the word "veterinary" and the conclusion reached is that it may be included under either Agriculture or Science. Even if so included in either, one wonders whether such inclusion is justified and whether the number of scholarships awarded to medicine bears a fair comparision to those awarded for veterinary work.

whether such scholarships be included in the term " Agriculture " or " Science."

In matters veterinary the prestige of Great Britain stands very high in the world. But is this prestige and position reflected by the composition of the Advisory Committees of the British Council ? They are composed, according to the Report, as follows:

> Drama Committee, with eight members ; Fine Arts Committee, with 19 members ; Law Committee, with 15 members ; Music Committee, with 16 members ; Universities Committee with 21 members ; Science Committee with 14 members.

The Science Committee has under it three panels, the Agricultural Panel with eleven members ; a General Science Panel with eight members ; and a Medicine Panel with eleven members. There is, as will be observed, no Veterinary Panel ; in fact, until the year under review there was no veterinary representation at all and in that year one veterinary surgeon was appointed to the Agricultural Panel.

This, to say the least, is an extremely unsatisfactory position. One may even say it is derogatory to the position which British veterinary science holds at the present time. Perhaps it explains why in appendix 7 of the Report, which gives the names of the lecturers and their subjects delivered in many countries overseas, there is not the name of a single veterinarian, although about 136 lecturers went on 151 tours.

The British Council is financed out of public funds. The work of the veterinary profession is basically responsible for a large portion of the public funds which enter the Treasury coffers. But apart from any such considerations it is more than unfortunate that there should be, either by intention or by neglect, such discrimination against veterinary work in this country. The time has come to ask the question " Why is there not a veterinary panel amongst the advisory committees of the British Council ? "

"FURTHER ASPECTS OF LAND RECLAMATION"

In a paper with the above title presented to the meeting of the Farmers' Club held on March 6th, Mr. Moses Griffith, M.Sc., of Aberystwyth, made the following points:—

1. There is a big unsatisfied need for a much larger food production in Britain, maybe up to well over 500,000 tons of fresh meat.

2. There are at least five million acres of hill land and marginal land capable of substantial improvement by various methods.

3. There are the necessary technical men with war-time experience of reclamation to supervise and advise on how to carry out this work.

4. There is sufficient supply of stock seed of the Aberystwyth grazing strains of grasses to grow enough seeds to reseed these lands to good leys if a campaign for increased production is put in hand right away.

5. There is in this country a substantial amount of track-laying tractors and heavy implements, the property of the Ministry of Agriculture, to form a nucleus to start the reclamation.

6. It is estimated that the pioneer crops and improved pastures on the reclaimed land would produce approximately 60,000 tons of fresh lamb and mutton annually once the scheme got under way. In addition, it would enable over a million more store cattle to be grazed on these areas during the summer months, and somewhere about 400,000 calves reared annually, to be grown into strong stores on the hill and marginal land and fattened on the lowlands. These would eventually mean an addition of somewhere in the region of 80,000 tons of home-produced beef supplies.

7. The farmers of such lands are ready and prepared to do their part if a sensible and fair scheme is put forward.

8. What is now required is leadership from the Ministry, and a reasonable and far-reaching marginal land scheme evolved, a scheme on very simple lines.

NOTES AND NEWS

Diary of Events

Mar. 22nd.—Meeting of the Technical Development Committee, N.V.M.A., at 36, Gordon Square, W.C.1, 10.30 a.m.

Mar. 23rd.—Annual Meeting of the Western Counties Division, N.V.M.A., at Exeter (The Rougemont Hotel), 2.15 p.m., to be preceded by Annual Luncheon (1 p.m.) and Meeting of Council (11.30 a.m.).

Mar. 24th.—Annual Meeting of the Biochemical Society, in the Department of Biochemistry, University College, Gower Street, W.C.1, 11.30 a.m. (Papers will be read and demonstrations given.)

Mar. 29th.—Meeting of the Association of Veterinary Teachers and Research Workers (Northern Region), at Messrs. Boots Veterinary Science Division, The Priory, Thurgarton, Notts, 12.30 p.m.

Mar. 31st.—Meeting of the Society of Veterinary Practitioners, at the Holborn Restaurant, London, W.C.2, 2.30 p.m.

Apr. 6th.—Meeting of the Central Veterinary Society, at the Royal Veterinary College, N.W.1, 2 p.m.

Apr. 14th.—Dinner Dance to be held by the Yorkshire Division, N.V.M.A., at Leeds (Guildford Hotel), 7.15 for 7.30 p.m.

April 18th.—Annual Meeting of the Southern Counties Division, N.V.M.A., at Bournemouth, 6 p.m.

Apr. 19th, 20th and 21st.—**Quarterly Meetings of Council and Committees, R.C.V.S.**

N.V.M.A. Council and Committees

The next Council and Committee Meetings of the Association will be held at the Royal (Dick) Veterinary College, Edinburgh, on April 26th, 27th and 28th.

The time-table is as follows:—

Wednesday, April 26th.
11 *a.m.* Veterinary State Medicine Committee.
2.30 *p.m.* Organising Committee.

Thursday, April 27th.
10 *a.m.* Home Appointments Committee.
11.30 *a.m.* Parliamentary and Public Relations Committee.
2 *p.m.* General Purposes and Finance Committee.

Friday, April 28th
11 *a.m.* Council Meeting.

R.C.V.S. Examinations

May 2nd.—R.C.V.S. Animal Management Examinations commence at Dublin.

May 9th.—R.C.V.S. Entries for D.V.S.M. Examinations due.

May 9th.—R.C.V.S. Pharmacology, etc., Examination (Revised Syllabus).

May 15th.—Written Examination.

May 17th.—Orals and Practicals (London and Dublin).

June 8th.—R.C.V.S. D.V.S.M. Written Examination commences, at Edinburgh.

June 22nd.—R.C.V.S. Membership Written Examination.

* * * * *

ROYAL COLLEGE OF VETERINARY SURGEONS

General Office and Central Library for Animal Diseases

As from FRIDAY, MARCH 17th, the entrance to the general offices of the R.C.V.S. and the Central Library for Animal Diseases will be on the ground floor of *No. 9*, Red Lion Square, and not on the first floor as hitherto.

* * * * *

PERSONAL

Births.—Bullen.—On March 4th, 1950, at " The Old Surgery," Horsheath, Cambs, to Catherine, wife of John J. Bullen, a daughter.

Carmichael.—At Raigmore Hospital, Inverness, on March 11th, 1950, to Nancy, wife of M. A. Carmichael, B.Sc., M.R.C.V.S., Achendaul, Spean Bridge, Inverness-shire, a son.

Harrison.—On March 4th, 1950, to Sheila and Peter Harrison, Stow-on-the-Wold, a son.

Thomson.—On March 2nd, 1950, at Woodcote Nursing Home, Beckenham, Kent, to Erica (*née* Hollander) and Alex. Thomson, M.S.R.C.V.S., a sister for Adrian, Colin and Rodney—Marilyn Erica.

Marriage.—LEFTWICH—HEWLETT.—The marriage took place on February 15th, 1950, at St. Gregory's Church, Plymstock, Plymouth, between Richard Bertram Leftwich, M.R.C.V.S., fourth son of Mr. and Mrs. B. R. Leftwich, of Pevensey, Sussex, and Bridget Mary Hewlett, only daughter of Mr. and Mrs. R. C. Hewlett, of Plymstock, Devon.

* * * * *

R.C.V.S. OBITUARY

RIPLEY, John Hubert, Wistaria Cottage, Ferndown, Dorset. Graduated London, July 16th, 1903. Died March 8th, 1950; aged 69 years.

WILLIAMS, William Rees, Capt. R.A.V.C. (T.F.), 15a, Chichester Road, Croydon, Surrey, formerly of Bridgend. Graduated London, July 15th, 1898; Fellow, December 2nd, 1905. Died December 14th, 1949.

WOODS, Herbert Stanley, J.P., formerly of South Africa. Graduated London, July 17th, 1909. Died in England in June, 1947. (Information just received.)

THE LATE CAPTAIN E. F. ANGLER, M.R.C.V.S.

A FURTHER APPRECIATION

Although I knew Captain Angler for only two years, I had the privilege of working under him for that time, and I could never have wished for a better teacher under whom to serve during my first difficult years in practice. Possessed of a great understanding of men, their strengths and weaknesses, he would never withhold information as to where one's own attributes lay.

He was imbued with a great love of horses, especially the Thoroughbred, and he would discuss their peculiarities for hours.

I remember him as a man of great good humour, straight, and always understanding and helpful, whether things were going all right or all wrong.

His oft-repeated injunction to me I shall always remember: "Never try to make an enemy, my boy, you will get plenty without trying."

W. P. G.

* * * * *

Foot-and-Mouth Disease Research Station at Pirbright

CHANGE IN ADMINISTRATION

It will have been seen from the Press that it has been decided to make an alteration in the administration of the Foot-and-Mouth Disease Research Station at Pirbright which for some years has been carried out by the Ministry of Agriculture. There is to be set up an independent governing body consisting of members appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland after consultation with the Agricultural Research Council and the Medical Research Council. The governing body will receive grant-aid from the Ministry for the research work, which will come under the scientific supervision of the A.R.C.

At a later date we hope to publish a further note on the composition of the governing body and the objects for which it is being set up.

* * * * *

WARBLE FLY

The Ministry of Agriculture is concerned at the extent of the damage to hides which is caused each year by the maggots of the warble fly. Records for the past few years show that about one British hide in every five is damaged by open warble holes, that is, holes through which the maggots have emerged within the previous three or four months. In addition, there is a very large number of hides which are imperfect owing to the damage caused at an earlier time. Although the holes through which the maggots have breathed may have become closed by the time the animals are slaughtered, the hides will have been permanently weakened and the leather, when processed, will show blemishes where the holes have been. The wastage in home-produced leather has to be made good by importation.

The Warble Fly (Dressing of Cattle) Order of 1948 prescribes that owners and persons in charge of cattle visibly infested with the maggots of the warble fly must dress those animals with a specified dressing within seven days of March 15th or as soon thereafter as the maggots appear under the skin of the cattle. It also requires the dressings to be repeated at monthly intervals for so long as the maggots continue to appear under the skin or until June 30th, whichever is the earlier.

The enforcement of the Order presents great difficulty, and there is little doubt but that many stockowners have in the past failed to fulfil the obligations that it imposes. The Ministry therefore asks veterinary surgeons to help in the campaign that is being conducted this year against this pest by impressing upon their clients the need for dressing infested cattle if the ravages of the warble fly are to be progressively reduced.

LEGAL NOTES

Cow with In-growing Horns.—The *Chester Chronicle* reports that, at Crewe Borough Sessions, Hubert Massey, Siddington Hall Farm, Chelford, was fined £10 with two guineas costs for permitting unnecessary suffering to a cow by not giving it proper care and attention. Represented by Mr. R. E. B. Smith (Audlem), defendant pleaded "Not guilty."

Inspector J. Proctor, Chester, for the R.S.P.C.A., said he saw defendant's cow in a pen at Crewe Cattle Auction. It was suffering from in-growing horns and appeared to be in pain. Pus was issuing from the head underneath the horns. The left horn had penetrated deeply into the head below the eye and the other horn was compressed tightly in the skin. He called in a veterinary surgeon, who administered an anaesthetic and cut away the ends of the horns. The left horn had penetrated the head to the extent of three-quarters of an inch and there was a superficial wound under the right horn. There was evidence that both horns had been cut previously.

Later he saw defendant at his farm and explained the condition of the animal to him, showing him the two pieces of horn which had been severed by the veterinary surgeon. Defendant said he accepted full responsibility. He did not wish to cause the cow any pain, and added that he had the horns cut last summer.

Replying to Mr. Smith, witness said the wounds could not have been caused by the cows jostling against one another in the pen.

Mr. Andrew D. Strang, veterinary surgeon, said the cow undoubtedly suffered considerable pain as a result of the in-growing horns.

Mr. Smith, for the defence, said Mr. Massey had had the cow for eight years and the last thought he had was to cause it pain. He farmed 159 acres of land with a stock of 80 and that was the first time he had been in trouble.

* * * * *

AGRICULTURAL SCHOLARSHIPS

The Ministry of Agriculture is again, as in past years, inviting applications for the undermentioned scholarships:—

Ten Senior Scholarships, tenable at University Departments of Agriculture, or Agricultural Colleges, for degree or diploma courses in an agricultural subject; or at Veterinary Colleges for courses in Veterinary Science.

Six Extended Junior Scholarships (for those who have already held Junior awards).

Sixty Junior Scholarships, tenable at Farm Institutes or similar institutions, for courses not exceeding one year in duration, in agriculture, horticulture, dairying or poultry husbandry.

The scholarships are open to the sons and daughters of agricultural workmen or of working bailiffs, smallholders and other rural workers whose means and method of livelihood are comparable with those of agricultural workmen, and to persons who are themselves bona fide workers in agriculture.

The value of the award is such that neither the recipients nor their parents are normally required to make any contribution towards the cost of the training provided.

Full information concerning the scheme may be obtained from the Secretary (Room 314), 1, Cambridge Terrace, Regent's Park, London, N.W.1, or from the Education Offices of County Councils.

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ANIMAL HEALTH TRUST'S CANINE RESEARCH PROGRAMME

In the course of his address at a public meeting in support of the work of the Animal Health Trust, held at Norwich on March 4th, Mr. S. F. J. Hodgman, M.R.C.V.S., stated that the subjects of investigations begun and contemplated at the Canine Research Station, at Kennett, near Newmarket, of which he is Director, included canine hysteria, neurotropic virus infection, blindness, cancer and puppy diseases, together with anaesthesia and the establishment of a breeding policy for dogs. In the very near future they hoped to inaugurate a regular diagnostic service that would be at the disposal of such general practitioners as might deem it advantageous to avail themselves of the resources of the Station in this respect. This era of prevention rather than cure in canine as in other spheres of veterinary medicine called for the creation of a cadre of veterinary specialists in this field, whose help and advice was readily procurable. Nowhere else was research into the diseases of dogs being carried out for the sake of the dogs themselves, in contradistinction to their role as "guinea pigs" in research.

ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

FOOT-AND-MOUTH DISEASE:

Berks.—Hurst Farm, Lambourne Woodlands, Newbury (March 9th).

Staffordshire.—Cross Farm, Cross Lane, Rolleston, Staffs (March 11th).

* * * * *

PARIS CONFERENCE ON TECHNICAL CO-OPERATION IN AFRICA

Proposals for a Joint Commission and Secretariat

A conference to discuss means of co-ordinating the work of technical experts in Africa south of the Sahara was held at Paris from January 11th to 14th, and attended by representatives of the Belgian, French, Portuguese, South African, Southern Rhodesian and United Kingdom Governments.

This meeting was the most recent of the series of conferences which began in 1945 when French and British delegates met to consider joint action on public health problems in West Africa. Since then, technical co-operation in subjects affecting the welfare of Africa's peoples has been extended to Africa south of the Sahara, and includes Belgium, Portugal, South Africa and Southern Rhodesia and their dependent territories. It has accordingly led to a common study of a very much wider range of subjects and to a pooling of resources and preparations for joint bureaux to deal with problems such as sleeping sickness, rinderpest, soil erosion and the spread of plant pests and diseases.

To regularise the existing *ad hoc* arrangements for technical co-operation on the metropolitan level, and to ensure more effective means of administrative liaison between the countries concerned, a conference of the interested Governments was held in London in September, 1949.

At the recently concluded conference in Paris these questions were further examined, and it was agreed to recommend the establishment of a "commission for co-operation in technical matters in Africa south of the Sahara" (CCTA), and the setting up of a Secretariat in London.

The commission will meet twice a year and will have administrative functions with the purpose, amongst others, of giving practical effect to technical co-operation in Africa.

The Secretariat, whose seat would be in London, would have the following tasks:—

(*a*) To review and co-ordinate programmes of technical co-operation in Africa south of the Sahara, including follow-up action in the execution of agreed measures to deal with problems such as rinderpest, sleeping sickness, soil conservation, etc.

(*b*) To draw up and submit to the Member Governments plans for further programmes of technical co-operation.

(*c*) To seek the approval of Governments for putting into practice the recommendations made at recent conferences.

Measures for technical co-operation between the Governments responsible for the administration of Africa south of the Sahara are in full accordance with the United Nations Charter, and, in particular with Article 73(d). This Article includes an undertaking "to promote constructive measures of development, to encourage research, and to co-operate with one another . . . with a view to the practical achievement of the social, economic and scientific purposes set forth in this Article."

* * * * *

ULSTER CATTLE INDUSTRY

"Chaotic" Effect of Milk Emphasis

"Things were fairly simple for the cattle breeders of Ulster some years ago, when emphasis was on beef production," said Mr. A. A. M'Guckian, a representative of the Cattle Committee of Ulster N.F.U., speaking at the first annual dinner in Belfast of the Ulster Shorthorn Breeders' Association, "but the prominence now being given to milk has brought considerable chaos to our cattle industry."

Proceeding with its report of the function, *Farming News* quotes Mr. M'Guckian as adding that a "terrific degeneration" had befallen their cattle stocks, and it had happened quite suddenly. It was up to the Shorthorn Association to accept the challenge thrown down by the times and try to bring some order back into the industry. When they had established the dual-purpose Shorthorn as the basic breed he thought they would have achieved a very good thing. He was sure the Association would rise to the task set by the Babbington Committee.

Common Policy Needed

Mr. J. Getty, a Ministry official, remarked that Mr. M'Guckian had sounded a very serious note with regard to the responsibility resting upon the Association. A grand opportunity lay in front of them if they would only get together and decide on a common policy in regard to the Shorthorn, which had always been, and he hoped would continue to be, the premier breed in Ulster. There were differences of opinion, it was true, but that was all to the good. If the Babbington Committee were right in their decision that the dual-purpose Shorthorn could fulfil the purpose necessary, then that was the ideal to set. It could be done if members put their backs into it. The breed had milking capacities, but the butterfat content was much too low. Speaking on behalf of the small committee working along with him, he said he had great hopes that the aim set was going to be achieved.

Record Cattle Population

Mr. D. A. E. Harkness, Permanent Secretary of the Ministry of Agriculture, Northern Ireland, stated that during the past few years their cattle population had shown a steady increase, despite the difficulties involved by the shortage of grazing due to compulsory tillage. Last year the number was 980,000—30 per cent. higher than at the outbreak of war and the highest recorded since the census started in 1847. It represented an increase of 200,000 on the figure which existed in 1939. He was sure the Association would play an important part in the development of Ulster as a cattle-producing country.

The aim of the Ministry, he added, was to help breeders to make the Shorthorns suitable in all respects for the smaller producer.

He had frequently been struck by the differences between Ulster and Scotland, his native country, in regard to milk production. They had in Ulster last year produced over 80,000,000 gallons from some 25,000 farms, whereas the Scottish M.M.B. had handled 150,000,000 gallons, nearly double the quantity, from under 8,000 registered producers.

In whatever direction the future swing might go, quite clearly it was going to be many years before the shortage of meat supplies could be eliminated.

Breeders were not unanimous concerning the best policy to pursue, declared Mr. R. A. Brown, vice-president of the Association. They still had those who continued to favour the Scottish beef Shorthorn. Time alone would show whether the promise of the committee of enquiry was to be fulfilled or not. He hoped that it would.

* * * * *

THE LIVESTOCK EXPORT GROUP

"During and since the war, in all walks of life," writes "Blythe" in *The Farmer and Stock-Breeder*, "societies, associations, groups and similar bodies have sprung up like mushrooms—there are too many of them. But a certain number, well organised and authoritative, are a necessary part of this complicated world and I should have thought that the Export Group was certainly one of these.

"The Group is recognised by the Ministry of Agriculture, the Board of Trade (at whose request it was set up during the war), Shipping Conferences and other official bodies. The export trade is beset by regulations regarding documentation, blood testing, quarantine, vaccination and so on—and some body must be able properly to represent the point of view of the breeders and exporters.

"Again, livestock exports are still severely hampered by the high cost of shipment. In recent months the Group has taken this matter up with certain Shipping Conferences and held discussions about it with the Ministry. Useful results have already come from this work.

"Breed societies will give their decision about the suggested new subscription and levy rates at a meeting on May 2nd. The long sighted will agree with these proposals. My only doubt on the subject is that an orgnisation limited to about £1,000 a year" (for which modest income the Group is appealing to the Breed Societies and its own members) "can adequately carry out all the work that should be done."

CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the N.V.M.A.

ELECTRICITY AND THE HORSE

Sir,—In a recent letter[1] I ventured to suggest the use of mild electric shocks for the cure of crib-biting and wind-sucking in horses, by electrification of the manger. It is of some interest that

I have received a letter from a Mr. A. J. Breaker, of Uxbridge, intimating that he cured a show-jumper of crib-biting by this means as far back as 1938.

Mr. J. D. Peele's very interesting report[2] of the electrocution of a horse at only 15 volts may raise doubts about the safety of such a procedure. Fatal electrocution at low voltage is essentially due to ventricular fibrillation, which can only supervene with the passage of the precise density of current required, through the heart itself, and in correct phase with the cardiac cycle.[3, 4, 5] Reassurance in the safety of the procedure in question follows from the facts that (*a*) the mouth is so acutely sensitive to electric current that only a few entirely innocuous milliamperes, probably below 5 ma., would be required; (*b*) direct current would be preferred to alternating current for the purpose on account of its specific sensory effects, and such current is at least five times safer fibrillogenically than A.C.[3, 7]; (*c*) by placing the second electrode on the head, the electrode-to-mouth current path becomes as short as desired, and this being in shunt with any earth-return channel through the heart and limbs, additional safety would be accomplished. For this "indifferent" electrode a simple wire-suture through the skin would serve excellently, probably better still for the "punitive" purpose in view if used in conjunction with enduring local anaesthesia ("Proctocaine," etc.) at this site.[6] Thus no danger whatever would attend a proper technique, though the converse is certainly true, and the warning implicit in Mr. Peele's case is not to be ignored.

Mr. Peele's ascertained figure of 15 volts is entirely out of line with the comparative data of Ferris *et al.*,[3] who find that the minimum fibrillogenic current in "large" animals, *viz.*, up to the 150 lb. calf and nine score pig, is a virtually linear function of the heart- and body-weight. The lowest fatal voltage on record (1930)[7] in man is 46 volts, and the requirement in the horse should accordingly be considerably higher. But there is much that is dubious about the accepted data in context, according to which (by extrapolation) the most concessionally low voltage to kill a horse would appear to be nearer 200 than 100 volts. From the same data, to kill an elephant something between 1,000 and 2,000 volts should be necessary—yet the writer has authentic information of the fatal electrocution of an adult elephant by the ordinary mains voltage. In this case, as in Mr. Peele's, a mouth-to-earth path was involved. The figures just cited are derived by computation upwards from animals of the weight of those of Ferris *et al.* It is the very interesting fact that, computing *downwards* on the basis of this elephant casualty and assuming average values for mains voltage and body-weight, it would appear that the requirements for fatal consequences in a small horse might well be met by something of the order of 15 volts! This creates a suspicion that the curve relating voltage and size is not properly linear but may flatten off perhaps in an exponential manner for animals above a few hundred pounds in weight. At all events the incongruities are transparent and serve only to illustrate the prevailing gaps in knowledge. With the increasing popularity of electric fittings and devices this state of affairs is unsatisfactory, and it would be of definite value if the profession would place on record every instance of the kind.

It is my submission that the suggestion,[8] following Mr. Peele's report, that electricity might be invoked for the emergency destruction of pit ponies, is to be most vigorously opposed in the present designated state of ignorance. There is no greater potential cruelty than the use of electricity for destruction where, as is the case here, the true requirements, instantaneous operation, and efficacy of the method are in any doubt.

Voltages as such are not, of course, the determinant, which is the current-level in relation to size, as decided by the voltage and the resistance presented (and other factors here unknown). Recognising that the (presumably) iron-shod feet of the horse could afford an exemplary earth-return, is it possible that the animal in question happened to have a "pricked foot"? In this event, and with a damp standing, very low resistance could obtain between the mouth and earth and accordingly heavy current might well pass. This improbable coincidence would offer to explain the occurrence without any difficulty.

I would like to mention that simple measurement by meter of the electrical resistance to D.C. between a horse's shoe and the subcutaneous tissues of the leg (using a hypodermic needle-electrode), should provide a method as elegant as it would be easy of application and presumably reliable, for the clinical diagnosis of pricked foot. Applied before, during and after removal of the nails it should immediately indict or acquit the one suspected, permitting confident differential diagnosis of the "prick" and the "nail-bind." Such a test should be 100 per cent. accurate, removing all doubts and saving much unnecessary and potentially injurious paring-out.

Yours faithfully,

E. O. Longley.

March 3rd, 1950.

References

1 Longley, E. O. (1949.) *Vet. Rec.* **61.** 769.
2 Peele, J. D. (1950.) *Ibid.* **62.** 54.
3 Ferris, L. P., King, B. G., Spense, P. W., & Williams, H. B. (1936.) *Elect. Eng.* **55.** 498.
4 Curtis, H. J., & Cole, K. S. (1944.) Glasser's Medical Physics, page 798.
5 Conrad, A. G., & Haggard, H. W. (1934.) *Elect. Eng.* **53.** 399.
6 Longley, E. O. (1950.) In Press (*Anaesthesia by Electricity*).
7 Kouwenhoven, W. B., & Langworthy, B. R. (1930.) *Trans. Amer. Inst. Elect. Eng.* **49.** 381.
8 Hughes, I. (1950.) *Vet. Rec.* **62.** 102.

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HARD PAD DISEASE

Sir,—In common with many veterinary surgeons practising in "hard pad areas" one has for some little time experienced considerable trouble and worry over the question of immunising dogs against distemper. I found in this practice that for quite a period every dog immunised by the serum/virus method went down with a clinical hard pad about three weeks after vaccination, and the great majority died.

In an endeavour to tide them over the dangerous post-inoculation period when they were almost bound to make contact with the hard pad virus we started about a year ago to give a protective dose of hard pad serum at the same time as the distemper inoculation. During the last year 25 to 30 dogs have been dealt with in this manner and it is interesting to note that no single case developed hard pad during the post-inoculation period, and further, that no single animal has since been presented suffering from that condition, in spite of the fact that a severe epidemic has been raging in this area during the whole period.

The numbers treated are, of course, small, and the time elapsed is short, so that it would be most unfair to formulate any definite conclusions, but it would appear that this method does give some fairly lasting immunity to hard pad disease.

I would point out that the method was evolved as a matter of pure clinical expediency, was in no way controlled, nor was it regarded as a scientific experiment. Various theories can be offered to account for the apparent success so far achieved, but I do not propose to enter into a controversial argument upon the subject at this stage. This letter is written purely to report clinical findings which may be of interest to other practitioners.

Yours faithfully,

L. Guy Anderson.

49, Cambridge Street,
Aylesbury, Bucks.
March 10th, 1950.

DISEASES OF ANIMALS ACTS, 1894 TO 1937, AND AGRICULTURE ACT, 1937 (PART IV).

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Fowl Pest	Parasitic Mange*	Sheep Scab	Swine Fever
Feb. 16th to 28th, 1950	22	2	1	—	2	—
Corresponding period in—						
1949	4	4	15	—	3	1
1948	5	—	27	—	1	1
1947	1	14	1	1	—	2
Jan. 1st to Feb 28, 1950	78	6	28	—	15	—
Corresponding period in—						
1949	28	5	87	—	13	4
1948	21	—	95	1	16	5
1947	10	63	1	1	13	10

Note.—The figures for the current year are approximate only.
* Excluding outbreaks in Army Horses.

Tuberculosis (Attested Herds) Schemes

The number of Attested Herds, *i.e.*, herds officially certified as free from Tuberculosis as at February 28th, 1950, was as follows:—

England	Wales	Scotland	Total (Great Britain)
19,930	14,021	12,415	46,366

NATIONAL VETERINARY MEDICAL ASSOCIATION

Annual Congress, Cardiff, 1950

PROVISIONAL PROGRAMME

All Papers will be presented and discussed at the Technical College, Cardiff.

SUNDAY, SEPTEMBER 3RD

7.00 p.m. "At Home" in the Whitehall Rooms, Park Hotel, given by the South Wales Division, N.V.M.A.

MONDAY, SEPTEMBER 4TH

10.30 a.m. Civic welcome by the Lord Mayor of Cardiff in the Cardiff Technical College.

11.00 a.m. Official opening of the Trades Exhibition in the Technical College.

11.15 a.m. Paper: "Factors Influencing Herd Fertility in Cattle." Writer: S. L. Hignett (Frant). Openers: D. W. Deas (Lasswade); J. Smith (Carmarthen).

2.00 p.m. Ladies' pleasure trip to Porthcawl, returning at about 5 p.m.

3.00 p.m. Film Show at the Technical College.

7.30 p.m. Civic Reception at Assembly Room, City Hall.

TUESDAY, SEPTEMBER 5TH

10.00 a.m. Paper: "Clinical Diagnosis of Diseases of the Abdomen in the Dog and Cat." Writer: J. S. J. Lauder (Hale Barns). Openers: Miss O. D. James (Cardiff); J. W. Heney (Dublin).

11.00 a.m. Ladies' pleasure trip to the Wye Valley, returning about 4.30 p.m.

11.30 a.m. Paper: "The More Obscure Diseases of the Pig." Writers: H. G. Lamont and D. Luke (Belfast). Openers: P. L. Shanks (Leeds); J. F. Timoney (Dublin).

2.00 p.m. Surgical and other demonstrations at Whitchurch Mental Hospital Farm:—
1. Soundness in the Heavy and Light Horse.
2. Modern Methods of Anaesthesia in Animals (*a*) Local, (*b*) General, in the Bovine, Equine and Small Animals.

5.00 p.m. N.V.M.A. Council Meeting in the Council Chamber, City Hall.

7.30 p.m. Annual Banquet in the Assembly Room, City Hall.

WEDNESDAY, SEPTEMBER 6TH

10.30 a.m. Paper: "Deficiency Diseases, particularly Acetonaemia." Writer: Dr. Carlstrom (Sweden). Openers: R. H. Smythe (Nottingham); J. R. Holmes (Liverpool University Veterinary Field Station).

2.30 p.m. Congress Photograph on the steps of the Museum.

3.00 p.m. N.V.M.A. Annual General Meeting at the Technical College.

7.30 p.m. President's Reception at the Country Club, St. Mellon's.

THURSDAY, SEPTEMBER 7TH

10.00 a.m. Paper: "Symposium on Sheep Diseases." Writers: S. Jamieson (Aberdeen); L. E. Hughes (Aberystwyth); W. T. Rowlands (Bangor); J. T. Stamp (Edinburgh). Openers: D. E. Davies (Cornwall); D. R. Allen (Cardiff).

11.45 a.m. Sectional Meetings.

Afternoon. (*a*) Bowls Competition at the invitation of the Barry Athletic Club. (Organiser: R. W. Hall, Barry.) Tea at the Merrie Friars Café, Barry, at the invitation of the President, South Wales Division—R. W. Hall.

(*b*) Golf Competition at the Penylan Golf Club. (Organiser: C. J. Pugh, Newport.)

8.00 p.m. Ladies' Guild Dance. Venue to be arranged.

FRIDAY, SEPTEMBER 8TH

10.00 a.m. Paper: "Diseases of the Ruminant Stomach." Writer: H. Begg (Strathaven). Openers: A. T. Morgan (Carmarthen); D. G. E. Davies (Llandyssul).

11.30 a.m. Paper: "S.19 and the Control of Brucellosis." Writer: J. R. Lawson (Weybridge). Openers: A. J. Wright (Macclesfield); and another.

2.30 p.m. Closing Meeting of the Congress at Cardiff Technical College.
Council Meeting N.V.M.A. at Cardiff Technical College.

N.V.M.A. CONGRESS AT CARDIFF

Hotel Accommodation

We are advised that hotel accommodation available in Cardiff at the time of the N.V.M.A. Congress (September 3rd to 8th inclusive) is limited.

Members are urged, therefore, to book their rooms as early as possible, and to facilitate this we reproduce below particulars of such block reservations as the Provisional Committee has been able to make. They are asked to note specially :—

1. That these particular reservations are contingent on applications being received from members at least two months prior to the opening of the Congress ;
2. That applications should be made direct to the hotel concerned and *not* to the Local Secretary ; and
3. That, in making application, members should mention the fact that they are veterinary surgeons attending the Congress.

	Block Reservations			(*All nett charges*)		
	Single Rooms	*Twin-Bedded Rooms*	*Double-Bed Rooms*	*Bed and Breakfast (Single)*	*Bed and Breakfast (Double)*	*Board Per Day*
Angel Hotel, Westgate Street, Cardiff... ...	10	6	5	19/6	39/–	30/6
Alexandra Hotel, Queen Street, Cardiff ...	—	4	2	14/6	29/–	23/–
Queen's Hotel, St. Mary Street, Cardiff ...	2	11	8	16/6	33/–	24/6
Barry's Hotel, St. Mary Street, Cardiff ...	10	5	10	16/6	32/–	25/–
Sandringham Hotel, St. Mary Street, Cardiff...	12	6	3	15/–	30/–	23/–
Park Hotel, Park Place, Cardiff (Headquarters Hotel)	30	16	12	16/6	33/–	25/6
Marine Hotel, Barry Island	—	2	2	14/6	29/–	21/–
Barry Hotel, Barry	3	3	3	14/6	29/–	24/–
Esplanade Hotel, Penarth	6	6	6	15/6	31/–	25/6
	73	59	51			

ADDITIONAL HOTELS WITHOUT RESERVATIONS

We have also been furnished with the following list of additional hotels to which applications for accommodation also can be made. Here, again, the necessity for early application is stressed.

Railway Station Hotel, Station Approach, Cardiff.

Philharmonic Hotel, St. Mary Street, Cardiff.

Gwalia Hotel, Barry.

Ship Hotel, Barry.

Seafield Hotel, 14, The Parade, Barry.

PRIVATE HOTELS

"Cedars," Fidlas Road, Cardiff.
"Ashburton," 227, Newport Road, Cardiff.
Mrs. Kennett, 60, Park Place, Cardiff.
Mrs. Cleves, 8, Tydraw Road, Cardiff.
Hamilton Guest House, 82, Penylan Road, Cardiff.
Mrs. Hesbronder, 233, Allensbank Road, Cardiff.
St. David's Hotel, 103, Newport Road, Cardiff.
Mrs. Woodward, 193, Newport Road, Cardiff.
Mr. Begg, 36, Hamilton Street, Cardiff.
Mrs. Springett, 26, Column Road, Cardiff.
Lyndon Court Hotel, 191, Newport Road, Cardiff.